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FORCE PROVIDER SOLID WASTE CHARACTERIZATION STUDY

by

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This report examines the solid waste produced by a Force Provider base camp to evaluate the feasibility of waste reduction through an onsite waste-to-energy converter (WEC) and/or composter. For a five-day period in June 2000, the solid waste generated by soldiers at the Force Provider Training Module in Fort Polk, Louisiana, was quantified and characterized. The waste was categorized by type (e.g., kitchen waste, trash, cooking oil) and composition (e.g., cardboard, plastic) and analyzed to determine the quantity that can potentially be processed. The daily per capita waste production was found to be 4.1 pounds. Food service activities generate more than 80% of the waste, and packaging materials account for at least 40% of the total. It is estimated that a 50 kW electrical generation rate can be realized from Force Provider solid waste. Recommendations are also made to modify packaging to increase the heat of combustion for improved waste-to-energy conversion.

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SOLID WASTES	ENERGY CONVERSION	PACKING MATERIALS	REDUCTION
WASTE DISPOSAL	MILITARY FACILITIES	SANITARY ENGINEERING	DISPOSAL
FORCE PROVIDER	FIELD FEEDING	COMPOSTS	WASTES
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PREFACE

Military units deployed for training, peacekeeping, and combat generate large amounts of solid waste and wastewater. In a single day, a typical battalion-sized unit deployed for peacekeeping operations uses more than 20,000 gallons of water, generates an equal amount of wastewater, and creates more than a ton of trash. Commanders have identified these wastes as one of their most costly logistics and sustainment burdens.

During the initial stages of deployment, field expedient methods of solid waste disposal, such as burial and open-pit burning, take considerable time and resources and have negative environmental consequences. During sustained base camp operations, wastes are consolidated and then removed by civilian contractors, possibly jeopardizing the physical security of the camp and increasing the risk of terrorist activity.

The “Zero Footprint Camp” (ZFC) concept is a new approach that considers the materials previously thought of as wastes to be valuable resources, processing them into items needed within the camp, such as clean water, electricity, and heat. ZFC promises to substantially reduce the supply requirements and eliminate the environmental and tactical footprint in field deployed camps.

This report documents a solid waste characterization study performed at the Force Provider Training Module in Fort Polk, Louisiana, to evaluate the feasibility of waste reduction through onsite waste-to-energy conversion and/or composting. The work was performed by Hughes Associates, Inc., 3610 Commerce Drive, Suite 817, Baltimore, MD, 21227, during the period March 2000 to March 2001, under the auspices of the U.S. Army Natick Soldier Center’s Pollution Prevention in Acquisition Program, contract DAAD16-00-C-1005.

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EXECUTIVE SUMMARY

The solid waste produced by soldiers in the Force Provider Training Module in Fort Polk, Louisiana was studied for a five-day period to determine the quantity and characteristics of the waste for use in Zero Footprint Camp (ZFC) systems. The waste was categorized by type (e.g., kitchen waste, trash, kitchen oil, etc.) and material composition (e.g., cardboard, polyethylene, aluminum, etc.) and analyzed to determine the quantity of waste that can be processed in a Composter or a Waste to Energy Converter (WEC), and the quantity that is unable to be processed in ZFC systems. The source of the waste within the camp was determined in order to develop recommendations on where to physically locate the ZFC systems when they are fielded. The original source of supply was categorized as military or non-military to determine whether changing military supply characteristics could improve the waste stream. In addition, the waste produced by the Joint Readiness Training Center (JRTC) in Fort Polk was quantified to compare its waste stream generation rates to Force Provider rates.

Based on the results of this study, a Force Provider Module will generate the quantities of waste shown in the table below. This translates to approximately 2500 lb./day (700 ft³/day) of solid waste during sustained operations for a full Force Provider with a population of 605 soldiers (550 soldiers and 55 Force Provider Staff). Approximately 400 lb./day (10 ft³/day) of this is waste is slop food waste with a high water content that may be suitable for composting, if a Composter is used, or increasing the water content of the rest of the waste, which may be necessary for efficient processing in the WEC.

Daily Per Capita Waste Weight and Volume Generation Rates

Waste	Weight	Volume
	lb./person/day	ft³/person/day
Trash and Kitchen Waste	3.2	1.12
Slop Food	0.7	0.02
Cooking Oil	0.2	0.004
Total	4.1	1.14

Greater than 80% of Force Provider waste is generated at the Food Service Facility. As a result, this is the recommended location for any ZFC solid waste systems to minimize handling of the waste.

Either a WEC alone or a WEC in combination with a Composter can be used with approximately the same benefits. When a WEC is used by itself, the volume reduction is 1.4% greater (97.6% vs. 96.2%) than when used in combination with a Composter. The projected electrical generation is 2% greater (51 kW vs. 50 kW) in this situation. In addition, the WEC may work more efficiently if it requires waste with a high moisture content since the slop waste will be processed in the WEC and not a Composter. If a WEC is used in combination with a Composter, some of the final material will be useful enriched soil, not just ash; however, the volume reduction is not as great. Because the improvement of benefits of using a Composter in addition to a WEC are not all that significant, it is recommended to use a WEC in combination with a Composter only if the WEC cannot efficiently process food slop.

The JRTC waste is produced at a slightly higher rate (20%) than Force Provider waste, at 4.8 lb./person/day. The rest of Fort Polk generates waste at a much higher rate—8.0 lb./person/day. These increased rates are due to differences in activity and mission.

Redesigning packaging and other materials through the Designer Trash program will have a great impact on the characteristics of Force Provider solid waste. Because the majority of the waste, greater than 95%, comes from military sources of supply, and are materials that are controlled by the military, any changes in the composition of these materials will directly impact the supplies used by a Force Provider. At least 40% of Force Provider waste originates as supply packaging. This includes materials such as cardboard, glass, metal, plastic, wax paper, and MRE packaging. Replacing glass and metal in the packaging materials with plastic provides the greatest potential for improving the heat of combustion of the waste by increasing it 35% or more. Replacing 50% of the cardboard packaging with plastic packaging will increase the heat of combustion another 17% for a total of a 52% higher heat of combustion when compared to the current waste stream. In addition, the volume reduction will be improved from 97.4% to approximately 99.8%. Depending on the type of energy generated, electrical output would be boosted from 50 kW to a maximum of 63 kW (a 26% increase), the number of 120,000 BTU/Hour Area Space Heaters displaced would increase from four to five (20% increase), or the number of M-80 water heaters displaced would increase from three to four (25% increase).

Because these improvements in the heat of combustion are substantial, it is recommended that the Designer Trash program should be implemented to improve base camp waste for more efficient processing. The program should focus first on developing packaging that can be completely processed (no glass or metal), and then on increasing the heat of combustion by substituting materials such as cardboard with plastic wherever possible.

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FORCE PROVIDER
SOLID WASTE CHARACTERIZATION STUDY

1.0 INTRODUCTION

A Force Provider Module is a containerized, pre-configured base camp that contains all of the materiel necessary to provide climate-controlled billeting, quality food and dining facilities, hygiene services, and Morale, Welfare and Recreation (MWR) facilities to support 550 personnel with a staff of 55 soldiers. Force Provider comes complete with water and fuel storage, power generation and distribution, and waste water collection systems. Missions for Force Provider include theater reception, intermediate staging base, rest and refit and base camps for other military operations such as humanitarian and disaster relief, and peacekeeping missions. Assistant Product Manager (APM) Force Provider is currently working on modernization plans that focus on increasing the efficiency of the Base Camp while decreasing the logistical footprint and operations and maintenance (O&M) costs, including the elimination of waste by utilizing Zero Footprint Camp (ZFC) equipment and concepts [1].

The need for proper management of waste in combat has been recognized for generations; however, field waste management has not advanced much in the last hundred years. Combat waste is generally collected and removed, burned, or buried. Traditional environmental compliance methods only reduce the waste through treatment, and will not eliminate it. In contrast, the ZFC will utilize 'wastes' as resources to create needed products within the camp and completely eliminate wastes. The products created through ZFC systems can include clean water, compost, electricity, heated water, and heated air. The four initial thrusts for ZFC currently under development are listed below.

1. Producing both potable and non-potable water from wastewater with a Water Processing Plant (WPP).

2. Producing energy in the form of electricity and/or heat from trash and other wastes that are efficiently processed with a Waste to Energy Converter (WEC)

3. Producing enriched soil from food slop, WPP sludge, kitchen and any other wastes that are efficiently processed with an in-vessel Composter. This thrust will only be completed if necessary. It was initially believed that the Composter was essential for wastes with a high water content; however, recent innovations in WEC technology have developed equipment that not only process wet waste well, but actually require waste that has an average water content of 15%–20% for optimal processing. As a result, a Composter may not be necessary.

4. Integrating and optimizing processes and supplies for efficient processing by ZFC systems through the Designer Trash program.

The last three thrusts focus on the use of non-hazardous solid 'waste' as a resource. In order to support these thrusts, 'waste' generation planning factors will be needed for determining: 1) the size of ZFC systems, 2) the quantity of energy and enriched soil that may be

produced, and 3) the extent to which the products can be improved through integration and optimization. Planning factors have been developed to quantify the amount of solid waste produced in the field that range widely—from as little as 1.64 lb./person/day to as much as 85 lb./person/day [2]; however, no planning figures currently exist for base camp operations similar in size and composition to a Force Provider Module. It is expected that base camps with the same mission as Force Provider will have similar waste; however, the planning factors are much higher for field activities that include initial camp construction and industrial activities (e.g., vehicle maintenance). Permanent, fixed installations generate approximately 9 lb./person/day and an overseas air base that performs aircraft and ground vehicle maintenance generates 21.2 lb./person/day [3]. An analysis of field feeding waste of a field artillery unit concluded that the unit generates an average of 1.04 lb./soldier/meal, or approximately 3.12 lb./soldier/day [4].

2.0 OBJECTIVE

The objective of this study was to quantify and characterize the 'solid waste' production rates of a US Army Force Provider Module during normal operations in order to develop planning factors. These planning factors will be used to develop performance requirements for ZFC systems, including a WEC and possibly a Composter. The planning factors included the quantity of daily solid waste produced in terms of both weight and volume per soldier and per Force Provider Module. The weight-planning factor will be used in determining heat of combustion and throughput for the ZFC systems. The volume-planning factor will be used to determine the logistical implications associated with removal of this waste if ZFC is implemented. The characteristics of the waste are determined in order to quantify the type of waste that can be converted to energy, composted (if necessary), and / or is inert or unable to be efficiently processed and can be redesigned under the Designer Trash program.

3.0 APPROACH

The solid waste produced by soldiers in the Force Provider Training Module in Fort Polk, Louisiana was studied for a five-day period to determine the quantity and characteristics of waste for use in ZFC systems. The waste was quantified by: 1) waste type, 2) material composition of the waste, 3) source within the camp, and 4) original supply source.

The types of waste that were considered in this study were trash, kitchen waste, cooking grease, cooking oil, slop food, and other wastes. The trash and kitchen oil were quantified and characterized by material composition. The cooking grease, cooking oil, and slop food were weighed and measured for volume only – they were not characterized by material composition. The quantities of other wastes were determined by record search only.

The kitchen waste and trash were categorized by material composition and analyzed determine the weight, volume and heat of combustion of the individual materials and the overall waste stream. The final waste characteristics were examined to find the best method of processing the waste, the amount of ash and enriched soil generated, the amount of resulting energy produced, and the volume reduction obtained by processing. Material categories were developed and grouped according to corresponding heats of combustion. Heats of combustion for most materials were found in reference texts; however, in cases where no heat of combustion was available, testing was conducted to determine them.

In order to determine the best location for ZFC systems in the camp, it was necessary to determine the greatest source of waste in the camp. To accomplish this, trash liners were marked using different colored stripe for each area prior to shipping the bags to the site, as shown in Table 1. The tent and shelter numbers included for each source are also shown in Table 1 (a map of the Force Provider Training Module can be found in Appendix B that includes the tent and shelter numbers referenced in Table 1).

Table 1. Trash Bag Stripe Colors

Source	Associated Tent/ Shelter Numbers	Stripe Color
Administrative	41–50	None
Billeting	1–40	Black
Bath, Shower, and Laundry	55–62	Green
Food Service Facility	51–54	Blue

The possibility of improving the characteristics of solid waste produced by a Force Provider was analyzed to determine if it was practical, how to improve them, and what their effects would be. The practicality was determined by ascertaining the original source of supply to verify that the supplies originate from a military source. The materials in the waste available for substitution were analyzed to determine how to improve the waste stream. The effects were determined by calculating the heat of combustion and generation rate after substitution of the materials, the increase in energy produced by a WEC, the quantity of fuel saved, and the increase in overall volume reduction.

The waste production rates of the Joint Readiness Training Center (JRTC) on North Fort Polk were also quantified to verify that other field waste production rates on Fort Polk are similar to the Force Provider production rates. The weight of waste was determined by reviewing records kept by the Fort Polk Environmental Office. The approximate number of soldiers using the JRTC for training was determined by reviewing the JRTC records.

3.1 Preparation

A study methodology was developed to ensure the waste study was conducted in a timely, efficient and thorough manner. The initial plan, included as Appendix A to this report, was modified during the study execution to adapt to the daily routine of the soldiers using the Force Provider site, and changes in the focus of the ZFC program.

A pre-study site visit to the Force Provider Training Module at Fort Polk, LA from 23–24 May 2000 was conducted to aid in developing the final plan. During the pre-visit, a full site tour was conducted, including the North Fort Polk Solid Waste Consolidation Facility (SWCF) and wastewater treatment plant. Buildings, trashcans, and dumpsters were inventoried to determine the best method for trash collection during the study. This inventory can be found in Appendix A, Page 36. The initial plan was to consolidate all of the trash at the SWCF, however it was determined that this was not feasible due to the logistical difficulties of ensuring that the trash was delivered on time, lack of space in the SWCF, and concerns over shelter from the heat

and rain. Instead, the trash was consolidated on the Force Provider site at the maintenance shelter.

The study plan was coordinated with Jack Hardwick, the Force Provider Training Module On-Site Manager, to ensure the planned schedule, procedures and on-site locations for the study were acceptable and would be coordinated with the units operating and using the Module during the study period. The plan was also coordinated with Dr. Christine Hull, the Installation Hazardous Materials and Hazardous Waste Program Manager, to ensure that the plan complied with local installation regulations and procedures.

Other preparations for the waste study included shipping the materials to the site and pre-coordination with the unit through written instructions provided in Appendix A. The written instructions were provided to Mr. Hardwick, who delivered them to the Commander of the 691st Quartermaster Battalion, the unit that staffed the Force Provider Module during the study. The materials listed in the study plan were shipped to the site prior to the arrival of the study team.

3.2 Unit Information

The daily unit information was collected from records kept by Mr. Hardwick. The 691st Quartermaster Battalion was required to turn in daily status sheets to Mr. Hardwick that recorded the use of the facilities within Force Provider as part of their normal duties. The status sheets, which include the daily population, meals served, and use of latrines and showers, can be found in Appendix D. The data on these sheets were used to determine the per capita and per meal waste generation rates.

3.3 Characterization Method

3.3.1 Trash

The trash was collected, sorted, weighed, measured, and characterized using the method described below.

1. Trash was collected by the soldiers and consolidated at the maintenance shelter daily prior to 0830 hours. The study team checked all of the trashcans in the camp to ensure that they had been emptied, and moved all of the trash to Tent 21 for sorting, measuring, weighing, and collecting. Tent 21 was used for sorting due to construction in the maintenance shelter, and because it was unused, open to the air, and provided shelter from the heat and rain. The floor of the tent was protected using large, plastic tarps.

2. The trash from each day was characterized on the day after it was generated. For example, the trash for the 19th was sorted on the 20th, since it was not collected until the morning of the 20th.

3. Trash bags were sorted by area of origin within the camp as provided in Table 1.

4. Each trash bag was weighed using a Siltec PS100L scale, with a capacity of 100 lb. and an accuracy of 0.1 lb. Volumes were measured by using a standard tape measure to measure the approximate width, length, and height of each bag.

5. The trash bags were opened and contents were sorted by material category into lined containers or onto the tarp. As each container was filled, the liner containing the sorted trash was removed, and the weight and volume were measured as described above. Data were recorded using Data Sheet 2. Example data sheets are provided in Appendix A.

6. As the waste was weighed, it was visually inspected and characterized as being from either a military or non-military supply source (e.g., the post exchange, shoppette, etc.).

7. The trash was re-bagged and disposed of in the central kitchen dumpster.

3.3.2 Kitchen Waste

All of the trash was sorted into these categories; however, not all kitchen waste was sorted, since it contained food and liquids that can present a possible health hazard. In addition, 'Slop Food,' or wet food waste, was measured for weight and volume only, and was not characterized in any other way.

The kitchen waste was collected, sorted, weighed, measured, and characterized using the method described below.

1. Kitchen waste was collected in the dumpsters near the food service facility. Three dumpsters were used for the study, as shown in Figure 1. The soldiers consolidated the kitchen waste in the right and left dumpsters. The center kitchen dumpster was used to collect all of the sorted and weighed kitchen waste.

Figure 1. Removing Waste from Kitchen Dumpsters

2. The kitchen waste was characterized after each meal. The estimated depth of the waste in the dumpster, and the width and length of the dumpster were measured to determine the overall volume. The bags were removed from the dumpster and measured for weight and volume. Not all of the kitchen waste was completely characterized since some of it was putrid and

presented a higher health hazard than the waste from the rest of the camp. Instead, the majority of the bags were measured for weight and volume only, visually characterized, and then immediately placed into the central dumpster. If the kitchen waste clearly fit into one material category, it was noted. For example, cardboard boxes not mixed with other waste were marked as material category 1. The putrescible portion of kitchen waste was sorted, characterized, measured and weighed per the method described above for trash for two meals only. The characterization of the waste from these two meals was used to develop a representative composition for the Dining Area Waste to estimate the weight and volume of the individual waste categories for the kitchen waste for the rest of the meals.

3. All kitchen waste was assumed to come from a Military Supply Source.

4. The data were recorded using Data Sheet 2.

5. Problems and Limitations – Trash and Kitchen Waste

In general, trash and kitchen waste were collected according to the standard methodology described in section 3.3.1, 3.3.2, and the study plan in Appendix A. The exceptions to this methodology are listed below.

1. The study plan called for measuring the volume of the trash in a container with gradations marked on the inside. It was decided that measuring the bags with a tape measure would be more accurate than using a container with gradations due to the bulky nature of the waste in bags (the waste would have had to be compacted to fit in the container).

2. Although the study team arrived on the 19th of June, the trash and kitchen waste were collected and consolidated for characterization beginning on the 18th. The trash from the 18th was collected near the maintenance shelter, and was sorted on the evening of the 19th. It is suspected that this was not all of the trash from the 18th because: 1) the amount of trash was smaller than expected (see Figure 2), 2) dumpsters near the front of the camp were unlocked and in use, and 3) the study team found trash bags from the billeting and administration areas in the kitchen dumpsters. The dumpsters near the front of the camp were locked on the 20th so that all of the trash would go to the maintenance shelter or kitchen dumpsters.

3. The kitchen waste from both the 18th and 19th was weighed on the evening of the 19th. The waste from the 18th was collected in the right-side dumpster, and the waste from the 19th was collected in the left-side dumpster. Once weighed, all of the waste was supposed to be consolidated into the center dumpster. However, the bags holding the waste from the 18th were not tied shut, and spilled throughout the dumpster. In addition, a large portion of this spilled waste was underneath slop food that was impractical to remove from the dumpster by hand (See Figure 3). As a result, approximately half of the kitchen waste from 18th was weighed and measured. The rest of the weight was estimated based on measuring the overall volume remaining in the dumpster.

Figure 2. Trash Collected on 18 Jun 00

Since this problem was due to untied bags and slop food, the study team asked the soldiers to make sure to tie the bags and to try to put them in the dumpsters right side up and to put less slop food in each bag to make them more manageable. The soldiers put the waste in the dumpster as requested, and this enabled the study team to completely measure the kitchen waste for weight and volume for the rest of the meals.

Figure 3. Unweighed Kitchen Waste

4. On the first day of the study, it was observed that the not all of the trash was placed in the pre-marked bags sent by the study team, and not all of the bags that were marked came from their assigned areas. To compensate for this for the rest of the study, a team member

collected the waste from the bathrooms and showers, and judgment was used based on the type of trash in the bag to determine its origin. After two days of sorting, the team was able to discern what trash came from which area. For example, a clear trash bag with wet paper towels was assessed to come from the bathrooms, a trash bag with carbon paper, forms, and coffee was assessed to come from the administration area, a trash bag containing lint was assessed to come from the laundry, etc. This judgment was needed for both unmarked bags and for trash incorrectly disposed of in the food service facility dumpster.

3.3.3 Grease, Oil, and Slop Food Waste

The daily production of cooking oil and grease per solider was measured. The volume of the oil and grease was measured, and the weight was calculated based on a standard density.

Grease is collected near the food service facility in a flow-through grease trap. The depth of grease was estimated using a wooden dipstick to stir the grease trap, and visually determine the depth of the grease on top of the water. The length and width of the grease trap were measured, and multiplied with the depth to determine the volume of grease within the trap.

Cooking oil is collected in a 55-gallon drum near the food service facility. The volume of the waste cooking oil drum was measured daily using a wooden dipstick. The dipstick was lowered into the drum until it hit the bottom, removed, and the level of oil on the stick was measured using a standard tape measure. The radius of the drum was measured, squared, and multiplied by pi and the depth ($\pi r^2 \times$ depth) to determine the volume of oil within the drum.

Slop food waste was mixed with the kitchen waste in the dumpster. Its volume and weight were measured using the same method as for the trash. When the slop food waste could not be moved in its original bag due to the possibility of the bag breaking, it was repackaged in a cardboard box before it was weighed. In this case, the scale was re-tared so the weight of the box was not included in the weight of the slop food waste.

3.3.4 Other Waste

The quantity of other waste removed from the site for disposal was determined by reviewing records from the Fort Polk Environmental Office. Examples of other types of waste include: construction waste, waste motor oil, hazardous waste, tire waste, and any other wastes removed from Force Provider Training Module not covered in other sections of this study.

3.4 Heat of Combustion Determination

The heats of combustion for most material categories were found in reference texts; however, in cases where no heat of combustion was available, testing was conducted. The testing was conducted using the ASTM E1354, Standard Test Method for Heat and Visible Smoke Release Rates for Materials and Products using an Oxygen Consumption Calorimeter [5]. This standard is commonly referred to as the Cone Calorimeter test, and is used to determine the following parameters of a material exposed to a specified irradiance level:

1. Effective heat of combustion (BTU/lb. or MJ/kg). This will be less than the oxygen-bomb value of the heat of combustion since the combustion is incomplete (as it is in real fires).

2. Peak rate of heat release (kW/m^2)

3. Rates of heat release averaged over various time periods, starting with the time of ignition (kW/m^2)

4. Mass loss rate per unit area ($kg/s\ m^2$)

5. Percent specimen mass loss (%)

6. Time to ignition (s)

7. Average smoke specific extinction area (m^2/kg). Smoke production from a material has the rational units of m^2, representing the extinction cross-section of the smoke. This is normalized by the amount of specimen mass loss (kg)

8. Average yields of each of the measured gas species (kg/kg)

The test is conducted using a 100 mm by 100 mm sample is placed beneath the conical shaped heater that provides a uniform irradiance on the sample surface, as shown in Figure 4. The sample mass is constantly monitored using a load cell and the effluent from the sample is collected in the exhaust hood above the heater. In the duct downstream of the hood, the flow rate, smoke obscuration, and O_2, CO_2 and CO concentrations are continuously measured.

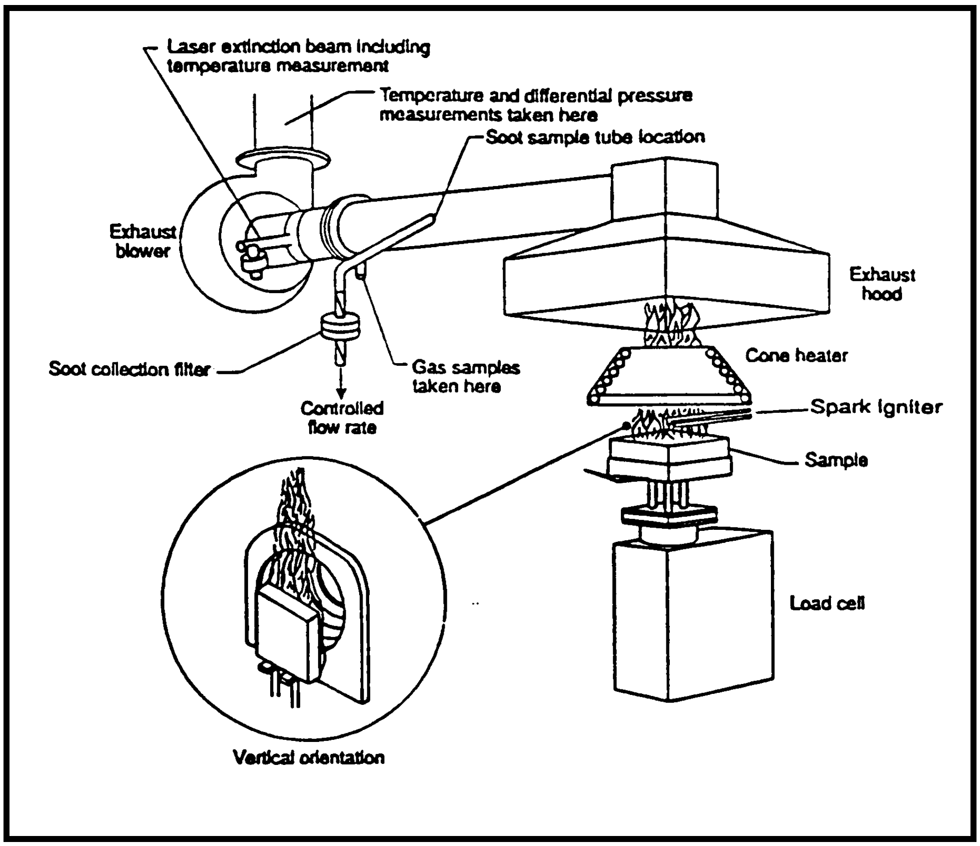

Figure 4. ASTM E1354 Cone Calorimeter Test Apparatus.

A spark igniter 12.5 mm from the sample surface is used to initiate the burning of any combustible gas mixture produced by the sample. Once the sample ignites, the burning of the sample causes a reduction in the oxygen concentration within the effluent collected by the hood. This reduction in oxygen concentration has been shown to correlate with the heat release rate of the material, 13.1 MJ / kg of O_2 consumed. This is known as the oxygen consumption principle. Using this principle, the heat release rate per unit area of the sample is determined with time using measurements made in the duct. Samples are typically tested at a range of irradiance levels (from 5 to 100 kW/m^2) to evaluate their performance when exposed to different heat loads. The samples tested for this study were exposed to an irradiance level of 50 kW/m^2.

4.0 RESULTS

The data were collected per the methodology described above, and can be found in Appendices C–F. The data were entered into a spreadsheet, processed, and summarized into tables provided below. Calculations for this section can be found in Appendix G. The results of the collected and processed data verify that the waste coming out of each area of the camp was a consistent, steady stream of trash with predictable characteristics.

4.1 Unit Information

The daily unit information from Appendix D is summarized below in Tables 2 and 3. This information is used as the basis for determining per meal and per soldier waste generation rates. The unit did not provide a status sheet for 22 Jun 00. The data were assumed to be the same as on the 21st, as shown in Table 1. The team left the study site on the afternoon of the 23rd. As a result, the dinner from this date is not included in the totals on Table 3.

Table 2. Population, Meal, and Shower Usage

	Services	Dining Facility			Personnel on site				
Date	Showers	Breakfast	Lunch	Dinner	Host Solders	Attached Soldiers	Customer Soldiers	Visitors	Total
18-Jun-00	121	150	57	115	31	26	108	0	165
19-Jun-00	153	136	57	160	31	26	108	0	165
20-Jun-00	158	140	57	160	31	26	108	0	165
21-Jun-00	153	150	63	168	31	26	108	6	171
22-Jun-00[1]	153	150	63	168	31	26	108	6	171
23-Jun-00	146	111	63	N/A	31	3	108	3	145
								Per Day Average	163.7

1. Estimated from 21 Jun 00

Table 3. Meal Summary

Total persons per meal For the entire study Period	
Breakfast[1]	837
Lunch[1]	360
Dinner[2]	771

1. Breakfast and Lunch for 18–23 Jun 00
2. Dinner for 18–22 Jun 00

4.2 Material Categories and Heats of Combustion

The material categories and their heats of combustion are shown in Table 4. The material categories in the original plan for the study are categories 1–20. Material Categories 40, 41, and 42 were planned as composite categories for Dining Area waste, Kitchen Area waste, and Billeting Area waste, respectively. Categories 21–30 and 43 were added on site when a waste material was found that did not fit into another category.

The composite categories were used to estimate the composition of waste that was not sorted and characterized. During the course of the study, it was discovered that most of the materials coming out of the Kitchen Area (food preparation and sanitation areas) were either slop food waste, cardboard boxes, or cooking oil and grease. Since these materials were all quantified individually and did not need to be estimated, Category 41 was unneeded, and dropped from the list.

All of the heats of combustion shown in Table 4 were either 1) determined from reference texts, 2) estimated based on similarity to other materials, 3) averaged for several materials that fit in to the category, or 4) determined through experimental testing.

The heats of combustion of the following materials were estimated:

1. Cardboard – Estimated to be similar to brown paper.
2. Slop Food Waste – Estimated based on the heat of combustion of food with a high percent water content.
3. Nylon – It was assumed this was Nylon 6.
4. Batteries – The theoretical heat of combustion was calculated based on heats of formation of individual constituents in standard alkaline batteries.

The heats of combustion of the following materials were based on an average:

1. Wood – Estimated by averaging the Heat of Combustion for miscellaneous types of wood.
2. Polyethylene and Polypropylene Plastics – Estimated by averaging the Heats of Combustion of the two materials, which were similar.
3. Dining Area Waste – Based on calculations shown in Appendix G, Table G-4.
4. Billeting Area Waste – Based on calculations shown in Appendix G, Table G-2.

Table 4. Material Categories and Heats of Combustion

#	Material Category	Heat of Combustion[1] BTU/lb.
1	Cardboard[2]	7370
2	Fabric – Acrylic	13232
3	Fabric – Cotton	7974
4	Food[3]	2370
4a	Slop Food (Wet Food)[2]	1000
5	Glass	0
6	Leather	8620
7	Metal – Aluminum	13378
8	Metal – Iron	3185
9	Metal – Magnesium	10654
10	Paper – Brown	7370
11	Paper – Magazine	5474
12	Paper – Newsprint	8491
13	Paper – Wax	9267
14	Plastic – Polyethylene Terephthalate	9560
15	Plastic – Polyethylene, Polypropylene[4]	20043
16	Plastic – Polyvinyl Chloride	7737
17	Plastic – Polystyrene	17111
18	Tire Rubber	14051
19	Unopened MREs[5]	5458
20	Wood[4]	8189
21	Opened MRE Inner Packaging[5]	10275
22	Neoprene	7866
23	MRE Heaters[3]	11019
24	Soap[5]	9910
25	Nylon[2]	13663
26	Rock	0
27	Batteries[2]	1403
28	Cigarette Waste[5]	6040
29	Latex	16055
30	Lint[5]	5353
31–39	NOT USED	
40	Dining Area Waste[4]	6710
41	NOT USED	
42	Billeting Area[4]	9357
43	Paint Can	13400

1. Heats of combustion determined from reference [6] unless noted otherwise.
2. Estimated Value.
3. From reference [7]
4. Averaged Value.
5. Value found experimentally using the Cone Calorimeter.

The heats of combustion of the following materials were found experimentally using the Cone Calorimeter (test results can be found in Appendix F):

1. Unopened MREs
2. Opened MRE Inner Packaging
3. Soap
4. Cigarette Waste
5. Lint

Although heats of combustion are shown for aluminum, iron, and magnesium, the minimum temperatures for combustion of these materials are 1832°F, 1706°F, and 1153°F respectively. It was assumed for all calculations that the WEC will not exceed these temperatures. As a result, these materials will not contribute to the overall heat of combustion of the waste.

Plastic materials were separated into four groups due to their wide range of heats of combustion. The following plastic materials were considered Polyethylene Terephthalate: Hard bottles, including soda bottles, peanut butter jars, vegetable bottles, and other similar containers. The following plastic materials were considered Polyethylene or Polypropylene: plastic bags, 6-pack rings, milk and water jugs, juice and bleach bottles, straws, and screw-on lids. The following plastic materials were considered Polyvinyl Chloride: detergent/cleanser bottles and water pipes. The following plastic materials were considered Polystyrene: Styrofoam™, packing peanuts, egg-cartons, foam cups, and plastic forks/knives.

4.3 Trash and Kitchen Waste

The processed and summarized data from the trash and kitchen waste are presented in Tables 5–10. Table 5 shows the overall totals for density, weight, volume, and heat of combustion for the entire study period. The slop food waste is reported separately since it is viewed as the potentially compostable portion of the waste.

Table 5. Overall Totals for 18–22 Jun 00

	Density	Weight	Volume	Heat of Combustion
	lb./ft³	lb.	ft³	BTU/lb.
Trash and Kitchen Waste (Minus Slop Food)	3.4	2609	787	7400
Slop Food (Compostable)	43	543	11	1000
Cooking Oil[1]	57	48	1	16809
Total	N/A	3200	799	6500

1. Calculated from average oil waste per meal (see Appendix G)

Table 6 summarizes the average per person weight, volume, and heat of combustion produced for the entire study period.

Table 6. Weight, Volume, and Heat of Combustion Produced Per Person Per Day

For 18–22 Jun 00	Weight	Volume	Heat of Combustion
	lb./person/day	ft³/person/day	BTU/person/day
Trash and Kitchen Waste (Minus Slop Food)	3.2	1.12	24000
Slop Food (Compostable)	0.7	0.02	600
Cooking Oil	0.2	0.004	3400
Total	4.1	1.14	28000

Table 7 summarizes the total material content of each Material Category by weight and volume for the entire study period. The totals on the table include the weight and volume of the two composite material categories, 'Dining Area Waste' (Number 40) and 'Billeting Area' (Number 42) within the individual Material Categories. The table also includes the slop food weight (Material Category 4a) and the weight of non-combustibles (e.g., glass, rock, etc.).

Table 7. Material Category Content for 18–22 Jun 00

#	Material Category	Total Weight Per Material	% of Total Weight	Total Volume Per Material	% of Total Volume
		lb.	%	ft³	%
1	Cardboard	454.7	14.4%	184.5	21.6%
2	Fabric – Acrylic	0.0	0.0%	-	0.0%
3	Fabric – Cotton	11.4	0.4%	2.2	0.3%
4	Food	753.9	23.9%	66.9	22.2%
4a	Slop Food	542.5	17.2%	12.7	3.1%
5	Glass	10.5	0.3%	0.5	0.1%
6	Leather	0.0	0.0%	-	0.0%
7	Metal – Aluminum	28.3	0.9%	17.2	2.0%
8	Metal – Iron	46.9	1.5%	1.1	1.0%
9	Metal – Magnesium	0.0	0.0%	-	0.0%
10	Paper – Brown	507.8	16.1%	196.9	17.3%
11	Paper – Magazine	4.2	0.1%	0.1	0.0%
12	Paper – Newsprint	5.7	0.2%	0.8	0.1%
13	Paper – Wax	215.6	6.8%	102.3	8.2%
14	Plastic – Polyethylene Terephthalate	41.6	1.3%	13.7	1.7%
15	Plastic – Polyethylene, Polypropylene	143.4	4.5%	75.2	7.8%
16	Plastic – Polyvinyl Chloride	0.2	0.0%	0.0	0.0%
17	Plastic – Polystyrene	187.4	5.9%	209.9	9.0%
18	Tire Rubber	0.0	0.0%	-	0.0%
19	Unopened MREs	57.7	1.8%	5.4	0.7%
20	Wood	1.1	0.0%	0.1	0.0%
21	Opened MRE Inner Packaging	104.8	3.3%	35.6	4.4%
22	Neoprene	1.7	0.1%	0.2	0.0%
23	MRE Heaters	12.0	0.4%	1.6	0.2%
24	Soap	2.2	0.1%	0.0	0.0%
25	Nylon	3.0	0.1%	0.6	0.1%
26	Rock	0.2	0.0%	0.2	0.0%
27	Batteries	1.7	0.1%	0.0	0.0%
28	Cigarette Waste	8.5	0.3%	1.3	0.2%
29	Latex	0.1	0.0%	0.0	0.0%
30	Lint	0.2	0.0%	0.1	0.0%
43	Paint Can	3.6	0.1%	0.21	0.0%

Tables 8–10 summarize the trash and kitchen waste production by source of origin within the camp, original source of supply, and production of kitchen waste by meal. The logistical supply source amounts were based on the judgment of the waste study personnel. Examples of items that were considered from a non-military source included glass drink bottles, folding chairs, and magazines.

Table 8. Trash and Kitchen Waste Production by Source of Origin for 18–22 Jun 00

Source	Density	Weight		Volume	
	lb./ft³	lb./ person/ day	%	ft³/ person/ day	%
Administrative	2.17	0.08	2	0.04	4
Billeting	2.96	0.51	13	0.17	17
Bath, Shower, and Laundry	2.41	0.08	2	0.03	3
Food Service Facility	4.33	3.19	83	0.74	76

It was found that almost all of the trash and kitchen waste comes from military supply sources, as shown in Table 9. If the military supplies are changed, it will have a significant impact on the waste generated.

Table 9. Trash and Kitchen Waste Production by Logistical Supply Source

Source	Density	Weight		Volume	
	lb./ft³	lb./ person/ day	%	ft³/ person/ day	%
Military	3.92	3.6	97	0.93	95
Non-Military	2.25	0.1	3	0.05	5

The majority of packaging for hot meals (breakfast and dinner) is cardboard and metal cans, with a low overall heat of combustion, as shown in Table 10. The overall generation rate and heat of combustion of hot meals are both half that of MRE meal waste from lunches, which consists mostly of MRE packaging. The heat of combustion of the hot meals could be improved by changing the packaging materials for the food served at these meals to materials similar to those used for MREs.

Table 10. Kitchen Waste Production by Meal for 20–23 Jun 00

Meal[1]	Density	Weight	Volume	Heat of Combustion
	lb./ft³	lb./person served	ft³/person served	BTU/lb./person served
Breakfast	4.41	0.77	0.17	4056
Lunch	5.06	1.58	0.31	8267
Dinner[2]	4.27	0.73	0.17	4388

1. Meals were not separated on 18 and 19 Jun 00
2. No data taken for dinner on 23 Jun 00

4.4 Grease, Oil, and Slop Food Waste

The volume of the grease varied from day to day, not increasing throughout the week, as would be expected. This may be due to the use of surfactants in the dining sanitation facility that could emulsify the grease or overloading of the grease trap with a high flow rate that results in

the grease being flushed through the trap. If this was the case, any grease that was washed through the grease trap was discharged into the sanitary sewer for treatment at the installation wastewater treatment plant. As a result, this data was viewed as suspect and was not used in any calculations.

Table 11 summarizes the production of waste cooking oil from the kitchen. The data are an average of all of the oil produced from meals served during the study period and from all meals served prior to the study that contributed to the oil in the 55-gallon drum, for a total of 4,782 meals served.

Table 11. Cooking Oil Production

	Density	Weight		Volume		Heat of Combustion	
	lb./ft³	lb.	lb./ Person/ meal	ft³	ft³/ Person/ meal	BTU/lb. [1]	BTU/ Person/ Meal
Cooking Oil	57	155	0.1	3	0.0018	16809	1700

1. Approximate – Based on median value from [6].

4.5 Other Waste

The Fort Polk Environmental Office records did not show that any other type of waste was ever removed from the Force Provider Training Module. This does not mean that no other waste was generated; however, it is possible that these wastes could still be accumulating on site or have been removed and disposed of from another site. Since the mission of a Force Provider is primarily billeting and subsistence, it is not expected that it will generate other wastes (especially industrial wastes) in significant quantities. Example heats of combustion of other wastes are shown in Table 12. If the activities of a base camp do generate industrial wastes such as waste oil, the overall heat of combustion may increase greatly.

Table 12. Heats of Combustion for Other Types of Waste

Material	Heat of Combustion[1]
	BTU/lb.
Construction Debris	0
Waste Engine/ Fuel Oil	13,000–18,000
Hazardous Waste[2]	N/A
Tire Rubber	14051

1. All Values are from [6]
2. Would not be processed in Waste to Energy Converter.

4.6 JRTC Waste

The waste generation data for the JRTC and Fort Polk as a whole, as provided by the Fort Polk Environmental Office, are shown in Table 13. No unit rotated through the JRTC in December 1999, so this month is not used for the calculation of the average daily per capita waste generation rates for the JRTC. In addition, the population of the JRTC for March 00 is

unknown, so this month is also not used for the calculations of either the JRTC or Total Installation generation rates. The JRTC generation rate was based on 12 days per month, which is the length of time that a unit stays in the JTRC for each rotation. The core installation population is not measured on a daily basis, so it was estimated to be 8000 on average [8]. The high generation rate seen in December 1999 is most likely due to seasonal variation, packaging from the holidays, or a condensed pick-up schedule that included waste from the last week of November.

Table 13. JRTC and Fort Polk Waste Generation Rates

Month	JRTC Waste	JRTC Population	JRTC Generation Rate	Core Installation Waste[1]	Core Population (approx.)	Core Installation Generation Rate
	(ton)	(person)	(lb./person/day)	(ton)	(person)	(lb./person/day)
Nov-99	143	4600	5.19	938	8000	7.71
Dec-99	10	None	None	1133	8000	9.31
Jan-00	97	5000	3.24	902	8000	7.41
Feb-00	100	3900	4.28	970	8000	7.97
Mar-00	77	Unknown	Unknown	985	Unknown	Unknown
Apr-00	134	3500	6.37	948	8000	7.79
		Average	4.77			8.04

1. JRTC waste is not included in these totals.

4.7 Projected Force Provider Waste Generation

The waste generation rates shown in Table 14 are projected based on a full population of 550 tenants and 55 host (605 total) personnel.

Table 14. Projected Force Provider Waste Generation Rates

	Weight of Material	Volume of Material	Density of Material
	lb./FP/day	ft^3/FP/day	lb/ft^3
Trash and Kitchen Waste	2330	687	3.39
Cooking Oil	121	2.1	57.6
Total	2451	689	3.56

4.8 Projected Impact of Designer Trash on Force Provider

The Designer Trash program under ZFC seeks to improve the characteristics of base camp waste by changing the military materials supplied to base camps, focusing on packaging wastes. The majority of waste (greater than 95%) in base camps come from military supply sources as discussed in section 4.2, so it is known that changing military supplies will have a significant impact on the base camp waste. It was unknown how much of the waste comes from packaging, so in order to determine this, the material categories were grouped as either: packaging, food, personal/sanitation, unopened MREs/MRE heaters, or miscellaneous materials. These groups were summed and divided by the total to derive the percentage weight contribution

of each group shown in Table 15. Packaging wastes include cardboard, glass, metal, plastic, wax paper, wood, and opened MRE packaging. Food wastes include both food and slop food. Personal and sanitary item wastes include fabric, brown paper, magazines, newspapers, neoprene, soap, nylon, batteries, and cigarette waste. Unopened MREs and MRE heaters (both new and spent) are broken out because they are unique materials. The miscellaneous wastes are tire rubber, rock, latex, lint, and paint cans. The greatest percentage of waste by weight is evenly split between packaging and food at 40 percent, proving that changing packaging will have a significant impact on base camp waste.

Table 15. Material Category Groupings by Weight

	Packaging	Food	Personal/ Sanitary	Unopened MREs / Heaters	Misc.
Total	39 %	41%	17%	2%	< 1%

The projected magnitude of these impacts is shown in Tables 16, 17, and 18. The following assumptions were made for the projections of Designer Trash implementation:

1. All metal and glass wastes are military supply packaging wastes, as confirmed by this study.

2. The minimum changes that will occur are the following:

   - All metal and glass packaging is replaced with a plastic having a high heat content, such as polyethylene, which will have a similar weight as the current product.

   - All MRE plastic/foil packaging is redesigned to be plastic only, and the metal foil is removed.

3. The maximum changes that will occur include those listed above and the following:

   - All MRE cardboard boxes will be changed to a plastic having a high heat of combustion, such as polyethylene, which will have a similar weight as the current product.

   - A minimum of 50% of the cardboard waste is MRE cardboard packaging (the amount of cardboard that is from MREs was not measured during this study; however the study team estimates at least 50% of the cardboard is from MRE packaging).

The Heat of Combustion produced by Kitchen Waste and Trash, not including the waste kitchen oil, is shown in Table 16. The current waste stream includes the slop food that contains high amounts of water and has a low heat of combustion. If the slop food is segregated from the rest of the waste, the heat of combustion increases by 17%, however this material must still be composted. After the Designer Trash program is completed and implemented, the heat of combustion will be increased from the current 6300 BTU/lb. to 8500–9500 BTU/lb., or 35%–52%.

Table 16. Heat of Combustion of Force Provider Kitchen Waste and Trash

	Current Waste Stream	Current Waste Stream Without Slop Food	After Designer Trash Program (Minimum)[1,2]	After Designer Trash Program (Maximum)[1,2]
Average Heat of Combustion (BTU/lb.)	6300	7400	8500	9600

1. Including Completion and Implementation of the Designer Trash Program.
2. Includes Slop Food

The WEC will process the trash, kitchen waste and oil to produce either electricity or heat. The expected minimum energy outputs can be seen in Table 17. These are the minimum expected outputs because conservative conversion efficiencies were used. The actual conversion efficiencies will be dependent on the type of technology used for processing.

Although only three options are shown in Table 17, it is expected that in practice the waste may be converted to more than one type of energy. For example, the exhaust from an electrical generator could be run through a heat exchanger to heat either air or water.

At least one 60 kW generators will be displaced if the electrical generation is constant, as shown in Table 17. However, if the WEC only generates electricity for 8 hours per day, during peak demand hours, at least three 60 kW generators could be displaced.

The last two options are air and water that have been heated from a WEC through a heat exchanger. The WEC will not heat water unless it is wanted (i.e., there will be no hot wastewater to dispose of or cool). The projection for heated air is based on a standard 120,000 BTU/Hr. Area Space Heaters (ASH) used continuously. The projection for heated water is based on a standard M-80, 500,000 BTU/Hr., water heaters used eight hours per day. Water heaters are not typically used continuously.

The WEC processes waste and produces energy and ash. If used, the Composter processes the slop food waste and other compostable materials to produce usable enriched soil. Table 18 shows the expected overall volume reduction when a WEC processes the waste by itself, and when both the WEC and Composter are used.

When the WEC and Composter are used, it is assumed that the slop food volume will not be reduced through composting. Instead, slop food and a portion of the ash are turned into a usable material, so although the volume reduction is reduced by 1.4%, a usable product is created instead of unusable ash. However, the use of this ash with slop in a Composter still has to be tested prior to fielding.

After the Designer Trash program is completed and implemented, the volume reduction will be increased 3.6%–2.4% over the current waste stream.

Table 17. Projected Minimum Energy Output From Force Provider

Material Processed by WEC	Heat Content of 'Fuel'		Option 1: Electricity			Option 2: Heated Air		Option 3: Heated Water	
	Trash and Kitchen Waste BTU/Day	Waste Oil BTU/Day	kW-Hr/ day	kW Constant	Annual Fuel Savings gal.	Number of ASH[1] Displaced	Annual Fuel Savings gal.	Number of M-80[2] Displaced	Annual Fuel Savings gal.
Current Waste Stream	14620942	2025885	1219	51	37230	4	35040	3	43800
Current, Without Slop	14219843	2025885	1189	50	36500	4	35040	3	43800
After Designer Trash (Minimum)	16437533	2025885	1352	56	40880	5	43800	3	43800
After Designer Trash (Maximum)	18567808	2025885	1508	63	45990	5	43800	4	58400

1. 120,000 BTU / Hour Area Space Heaters used continuously.
2. M-80 500,000 BTU / Hour Water Heaters used 8 hours/day.

Table 18. Expected Volume Reduction After Processing for a Force Provider

Material Processed by WEC	Volume Prior to Thermal Processing	Volume Post Thermal Processing	Total Reduction	Volume Prior / Post Composting	Overall Volume Reduction
	ft³/FP/day	ft³/FP/day	%	ft³/FP/day	%
Current Waste Stream	689	3.0	97.6	N/A	97.6
Current, Slop Composted	679	2.8	97.6	26[1]	96.2
After Designer Trash (Minimum)	689	1.7	99.8	N/A	99.8
After Designer Trash (Maximum)	689	1.5	99.8	N/A	99.8

1. Includes both 10 ft³ of Slop for Composting and 2.8 ft³ of ash from thermal treatment.

5.0 CONCLUSIONS

Based on the results of this study, a Force Provider Module will produce approximately 2500 lb./day (700 ft^3/day) of solid waste during sustained operations, or 4.1 lb./person/day (1.14 ft^3/person/day). Approximately 400 lb./day (10 ft^3/day) of this is waste is slop food waste with a high water content that may be suitable for composting, if a Composter is used. Because most of the waste is generated at the Food Service Facility, approximately 80%, this is the ideal place to locate the WEC and Composter to minimize handling of the waste.

Either a WEC alone or a WEC in combination with a Composter can be used with approximately the same benefits. When a WEC is used by itself, the volume reduction is 1.4% greater (97.6% vs. 96.2%), the projected electrical generation is 2% greater (51 kW vs. 50 kW) and the WEC may work more efficiently if it requires waste with the high moisture content provided by the slop waste. If a WEC is used in combination with a Composter, the volume reduction is not as great; however, some of the final material will be useful enriched soil, not just ash.

The JRTC waste is produced at a slightly higher rate (20%) than Force Provider waste, at 4.8 lb./person/day. It is expected that the composition of this waste will be similar to Force Provider waste. This increase rate is most likely due to packaging waste from materiel unloaded by units after reaching the JRTC. Both of these rates are higher than the 3.12 lb./person/day produced by a field artillery unit. This shows that the waste generation is highly dependent on the activity, even in field conditions.

The Non-JRTC Fort Polk installation waste generation rate is even higher at 8.0 lb./person/day. This increased rate is probably due to the high amount of industrial and commercial activity on Fort Polk as compared to the Force Provider Module.

Redesigning packaging and other materials through the Designer Trash program will have a great impact on the characteristics of Force Provider solid waste as evidenced by the following results.

1. The majority of the waste, greater than 95%, comes from military sources of supply, and are materials that are controlled by the military.

2. A large portion of the waste, 40%, is packaging waste, including cardboard, glass, metal, plastic, wax paper, and MRE packaging. Approximately 10% of this waste is metal and glass with no heating value, which could be changed to a plastic with a high heating value.

3. The heat of combustion of MRE packaging, 10,275 BTU/lb. could be improved to be as much as 20,000 BTU/lb. if all of the materials were changed to a material with a heat of combustion similar to polyethylene. In addition, volume reduction would be greater, since all metal foil and glass would be removed from the new packaging.

4. The majority of packaging for hot meals is both cardboard and metal cans, with a low overall heat of combustion. The overall generation rate and heat of combustion of hot meals are both half that of MRE meal waste from lunches, which consists mostly of MRE packaging.

The heat of combustion of the hot meals could be improved by changing the packaging materials for the food served at these meals to materials similar to those used for MREs.

5. When the Designer Trash program is completed and implemented, the overall waste stream will have heat of combustion that is increased between 35% and 52% over the current waste stream. In addition, the volume reduction will be improved from 96.2% to approximately 99.8%. Electrical output would be boosted from 50 kW to a maximum of 63 kW (a 26% increase) or the number of 120,000 BTU/Hour Area Space Heaters displaced would increase from four to five (20% increase) or the number of M-80 water heaters displaced would increase from three to four (25% increase).

6.0 RECOMMENDATIONS

The WEC should be used in combination with a Composter only if the WEC cannot efficiently process food slop, otherwise a WEC alone is recommended since the improvement of benefits of using a Composter in addition to a WEC are not significant.

The Designer Trash program should be implemented to improve base camp waste, because the projected improvements in the heat of combustion are substantial. The program should focus first on developing packaging that can be completely processed (no glass or metal), and second on increasing the heat of combustion by substituting materials such as cardboard with plastic wherever possible.

When conducting a waste study similar to this one, the following recommendations are made:

1. Personal pre-coordination with the unit is highly recommended. The study team should arrive one day prior to waste collection, and pre-coordinate the following as a minimum:

    - Place marked bags in trashcans personally on the first day of the study.
    - Verify time and location of the daily consolidation of the trash and kitchen waste.
    - Ensure no hazardous materials, medical waste, or spent rounds are put in the trash.
    - Ensure the trash bags are tied properly, not overfilled, and put right side up into the dumpster.
    - All dumpsters should be locked other than those used by the study team.
    - Measure and weigh slop food waste prior to putting it in a dumpster.

2. The study team completed their daily routine in 18 man-hours per day for the waste from 164 soldiers. Using this ratio, future study teams should expect it to take approximately 0.11 man-hours per soldier in the camp.

3. Plastic bins should be used to sort waste, especially lower density waste, since the wind will blow it around if it is not in a bin.

4. Coordinate the time for emptying the dumpsters with the on-post trash pick-up contractor prior to the study and upon arrival to ensure the dumpsters are not emptied before they have been characterized.

7.0 REFERENCES

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2. Conkle, H.N. Deployable Waste Management System. AFRL-ML-TY-TR-1999-4523. U.S. Air Force Research Laboratory, Tyndall AFB FL, June 1999.

3. Andel, J., et al. Deployable Waste Management System Study. AAC TR 00-09. U.S. Air Force Air Armament Center, Eglin Air Force Base FL, June 2000.

4. Rock, K., et al. An Analysis of Military Field-Feeding Waste. NATICK/TR-00/021. U.S. Army Natick Soldier Center, Natick MA, January 2000.

5. ASTM International. Standard Test Method for Heat and Visible Smoke Release Rates for Materials and Products Using an Oxygen Consumption Calorimeter. ASTM E1354-99. West Conshohocken PA, 1999.

6. Cote, A.E., and Linville, J.L., eds. Fire Protection Handbook, 17th edition. National Fire Protection Association, Quincy MA, 1991.

7. Hilgeman, T.R., and Fields, J.A. Disposal Methods for Flameless Ration Heaters and Meals, Ready-to-Eat for the Food Service Program. NATICK/TR-00/017. U.S. Army Natick Soldier Center, Natick MA, September 2000.

8. Website: <http://www.dmdc.osd.mil/sites/owa/Installation.prc_ViewFrame?p_Site=2965&p_Subject=01&p_SID=QZABKSKZWYZ>, December 2000.

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APPENDIX A – FORCE PROVIDER WASTE STUDY PLAN

Force Provider Waste Study Plan

Purpose: To quantify and characterize the solid waste produced by a Force Provider Unit.

Background: The Zero Footprint Camp (ZFC) concept seeks to use 'waste' from within Force Provider and other base camps as inputs into processes in a manner that fully eliminates any waste from the camp. The quantity and type of 'waste' resulting from supporting units in the field is required in order to be determine the throughput available for the equipment needed to process the waste into heat, electricity and/or fuel that will be used within the camp.

Objective: A report will be produced from this data illuminating the quantity and type of solid waste produced by a Force Provider unit. The data from this study will be entered into a spreadsheet format and included in the report. After this study is complete, the data will be used to determine the size and type of equipment necessary for ZFC.

Data to be collected:

1) The 'trash' and kitchen waste produced per person per day in Force Provider. The weight and volume of the solid waste will be measured for the following categories:

a) Type of Waste. The types of waste are grouped according to their heating values. The groups are listed in Table A-1, along with their heating values.

Table A-1. Heating Values of Materials

Material	Heating Value	
	MJ/Kg	BTU/lb.
Cardboard[1]	17.1	7370
Fabric – Acrylic	30.7	13232
Fabric – Cotton	18.5	7974
Food	low	low
Glass	0	0
Leather	20.0	8620
Metal – Aluminum[2]	31.0	13378
Metal – Iron[3]	7.4	3185
Metal – Magnesium[4]	24.7	10654
Paper – Brown	17.1	7370
Paper – Magazine	12.7	5474
Paper – Newsprint	19.7	8491
Paper – Wax	21.5	9267
Plastic – Polyethylene Terephthalate[5]	22.18	9560

Table A-1. Heating Values of Materials (cont.)

Material	Heating Value	
Plastic – Polyethylene, Polypropylene[6]	46.5	20043
Plastic – Polyvinyl Chloride[7]	17.95	7737
Plastic – Polystyrene[8]	39.7	17111
Tire Rubber	32.6	14051
Unopened MREs	TBD	TBD
Wood[9]	19.0	8189

Source: Fire Protection handbook, 17th ed., AE Cote and J. Linville, eds., National Fire Protection Association, Quincy, MA (1991).

1. Approximate - Assumed to be similar to brown paper
2. Minimum temperature necessary for combustion - 1832°F (These temperatures may be a design consideration)
3. Minimum temperature necessary for combustion - 1706°F (These temperatures may be a design consideration)
4. Minimum temperature necessary for combustion - 1153°F (These temperatures may be a design consideration)
5. Hard bottles, including soda bottles, peanut butter jars, vegetable bottles, etc.
6. Average value - includes plastic bags, 6-pack rings, milk and water jugs, juice and bleach bottles, straws, and screw-on lids
7. Detergent/cleanser bottles, pipes
8. Styrofoam, packing peanuts, egg-cartons, foam cups, plastic forks/knives
9. Average for miscellaneous types of wood

b) Origin of Waste. The source for the waste within the camp will be determined. The waste will be grouped into the following sources:

i) Billeting / Morale, Welfare and Recreation
ii) Laundry / Latrines / Shower
iii) Food Service
iv) Administration / chapel / medical or general support

c) Military vs. Non-Military. The waste will be grouped as originating from a military source of supply or from a non-military source of supply.

2) The cooking oil and grease produced per person per day in Force Provider. The volume of the oil and grease will be measured, and the weight will be calculated based on density. Oil and grease have the following heating value.

Material	Heating Value	
	MJ/Kg	BTU/lb.
Cooking oil and Grease[1]	39.0	16809

Source: Fire Protection handbook, 17th ed., AE Cote and J. Linville, eds., National Fire Protection Association, Quincy, MA (1991).

1. Approximate - Based on median value

3) Other wastes produced per person per day in Force Provider. The quantity (weight or volume, depending on the type of waste and available information) will be determined for any other waste types produced within the camp. Examples include the following:

Material	Heating Value	
	MJ/Kg	BTU/lb.
Construction Debris	0	0
Motor Oil[1]	42.5	
Hazardous Waste[2]	N/A	N/A
Tire Rubber	32.6	14051

Source: Fire Protection handbook, 17th ed., AE Cote and J. Linville, eds., National Fire Protection Association, Quincy, MA (1991).
1. Assumed to be similar to Fuel Oil No. 6
2. Would not be processed in Waste to Energy Converter

Data Collection Method:

1. Unit Information.

2. A member of the Force Provider staff will be interviewed to determine:
    a. The type of unit.
    b. The population of the camp (on a daily basis).
    c. The activities of the camp.
    d. Data will be recorded using Data Sheet 1. An example of this sheet is on Page 31.

3. Trash.
    a. Trash liners will be marked with a different colored stripe for each area listed in 1) above. This will be used to determine the origin of the trash within the camp.
    b. The standard practice is to collect and deliver trash from the Force Provider the North Fort Polk central consolidation point daily. For the study, the trash will be delivered to the maintenance shed for sorting and examining as indicated on Page 35. The trash will then be transported to the consolidation point. This will ensure that all of the trash leaving the camp is accounted for.
    c. Trash bags will be opened, and contents will be sorted into lined containers.
    d. As each container is filled, the liner containing the sorted trash will be removed, weighed, volume recorded, and put on a truck for delivery to the central consolidation point.
        i. Trash will be weighed using a Siltec PS100L Scale, which has a capacity of 100 lb. and an accuracy of 0.1 lb.
        ii. Volume will be measured using a large trashcan with 5-gallon gradations marked on the inside of the can. Gradations will be marked using a known volume of liquid poured into the can.
        iii. Data will be recorded using Data Sheet 2. An example of this sheet is on Page 32.

e. The volume of the bulk trash will be measured after sorting and re-packaging by measuring the dimensions of the trash bags within the truck. (e.g., the bed of the truck will be measured for width and length, and the depth of the trash will be measured). Data will be recorded using Data Sheet 4. An example of this sheet is on Page 34.

4. Kitchen Waste:
   a. The food service facility has two dumpsters that are emptied as necessary. During the waste study, three dumpsters will be used. One will collect the kitchen waste after each meal. The other two will be used for disposal of the kitchen waste after it has been quantified.
   b. Food waste will not be completely characterized, since it will present a health hazard. Only the waste containing utensils and napkins will be sorted. This may be modified depending on the condition of the actual waste (e.g., if it is all mixed with food, it will not be fully characterized).
   c. For the waste that will be examined, trash bags will be opened, and contents will be sorted into lined containers.
   d. As each container is filled, the liner containing the sorted trash will be removed, weighed, volume recorded, and disposed of properly.
      i. Trash will be weighed using a Siltec PS100L Scale, which has a capacity of 100 lb. and an accuracy of 0.1 lb.
      ii. Volume will be measured using a large trashcan with gradations marked on the inside of the can.
      iii. Data will be recorded using Data Sheet 2. An example of this sheet is on Page 32.

5. Grease, oil, and 'slop food' waste.
   a. Grease is collected in a grease trap. Oil and 'slop food' waste is collected in a grease trap and drum, respectively.
   b. The volume of each will be measured daily through container measurement and by using a dipstick—the dipstick may be a plastic yardstick, or may have to be developed in the field, depending on the container used.
   c. Data will be recorded using Data Sheet 3. An example of this sheet is on Page 33.

6. Other Waste.
   a. Records will be reviewed to determine the amounts of construction waste, waste motor oil, hazardous waste, tire waste, and any other wastes removed from the Force Provider Camp.
   b. Data will be recorded based on the information available.

7. Waste from JRTC:
   a. Weight and volume per solider of waste from JRTC will be obtained from the Fort Polk Environmental Office.

Schedule:

First Study: 19–23 June 2000
Second Study: 11–15 September 2000

The schedule is extremely flexible, and will be adjusted to coordinate with trash delivery and FP/JRTC rotation schedules.

Monday

Travel and Initial Coordination
- Set up area for trash characterization
- Determine initial volumes of grease and oil
- Coordinate trash delivery with waste management personnel
- Perform Records Search for other wastes
- Interview local environmental personnel about waste from both FP and JRTC

Tuesday, Wednesday, Thursday, and Friday

Characterize trash
Measure grease and oil
Coordinate trash delivery for the next day

Friday - PM

Characterize trash
Measure grease and oil
Travel

Equipment Necessary:

Item	Number	Bring/Buy On-Site
Scale	1	Bring
Trash Can (Various Sizes)	20	Buy
Trash Bags	400	Buy
Coveralls	3	Bring
Protective Mask	3	Bring
Gloves	6pr	Bring

Waste Study Plan

Data Sheet 1

Date	Unit Population	Weather	Recorder's Name

Data Sheet 2

Date: Time: Recorder's Name:

Material	Weight	Volume	Trash Can Identification #	Military/ Non-Military

<u>Data Sheet 3</u>

Date	Time	Grease/Oil	Depth	Volume (Calculated)	Weight (Calculated)	Recorder's Name

<u>Data Sheet 4</u>

Date	Time	Vehicle Type	Truck Bed Size		Depth of Trash	Number of Bags	Weight	Recorder’s Name
			Width	Length				

Preparation Instructions for Force Provider Waste Study

A waste study is being conducted on the Force Provider Training Module from 18-23 June 00. Trash will be sorted and weighed for each day. Trash from the Dining Facility will be weighed after each meal. The study team will arrive by 1600 hrs on 19 June. In order to complete this study properly, your cooperation and assistance would be appreciated.

Directions:

1. Sunday, June 18:
   a. Dispose of <u>Saturday's</u> trash according to Standard Operating Procedures.
   b. Remove all standard trash bags from trashcans.
   c. Replace trash bags with color-coded trash bags as shown in the table below.
   d. Use one bag to line the can and put the rest at the bottom of the can.
   e. Put all dining facility waste into **one** empty dumpster—the dumpster on the right.

Bag Color	Stripe Color	Location	Tent #s	Number of Bags per Can
Clear	Black	Billeting	1–40	6
Black	None	Administration, MWR, Chapel, First Aid Station	41–50	6
Clear	Blue	Dining Facility	51–54	18
Clear	Green	Latrines, Laundry, Showers, Maintenance Shell	55–63	6

2. Monday, June 19:
   a. Bring trash bags (other than dining facility bags) to the Maintenance Shell (Tent # 63) prior to 0800. Stack bags in a pile in a corner.
   b. Put all dining facility waste into a second empty dumpster—the dumpster on the left.

3. Tuesday–Friday, June 20–23:
   a. Bring trash bags (other than dining facility bags) to the Maintenance Shell (Tent # 63) each morning prior to 0800. Do NOT mix trash bags with the previous day's bags.
   b. Put all dining facility waste into **one** empty dumpster **after each meal**—the dumpster on the right.

FORCE PROVIDER TENT AND TRASH CAN INVENTORY

Tent Number	Facility Type	# of Trash Cans	Type of Trash Can	Trash Bags/ Study	Total Required	Marking
1	Billet	1	Plastic- Rubber Maid Trash Can - 32 Gallons	6	6	Black Stripe
2	Billet	1	Plastic- Rubber Maid Trash Can - 32 Gallons	6	6	Black Stripe
3	Billet	1	Plastic- Rubber Maid Trash Can - 32 Gallons	6	6	Black Stripe
4	Billet	1	Plastic- Rubber Maid Trash Can - 32 Gallons	6	6	Black Stripe
5	Billet	1	Plastic- Rubber Maid Trash Can - 32 Gallons	6	6	Black Stripe
6	Billet	1	Plastic- Rubber Maid Trash Can - 32 Gallons	6	6	Black Stripe
7	Billet	1	Plastic- Rubber Maid Trash Can - 32 Gallons	6	6	Black Stripe
8	Billet	1	Plastic- Rubber Maid Trash Can - 32 Gallons	6	6	Black Stripe
9	Billet	1	Plastic- Rubber Maid Trash Can - 32 Gallons	6	6	Black Stripe
10	Billet	1	Plastic- Rubber Maid Trash Can - 32 Gallons	6	6	Black Stripe
11	Billet	1	Plastic- Rubber Maid Trash Can - 32 Gallons	6	6	Black Stripe
12	Billet	1	Plastic- Rubber Maid Trash Can - 32 Gallons	6	6	Black Stripe
13	Billet	1	Plastic- Rubber Maid Trash Can - 32 Gallons	6	6	Black Stripe
14	Billet	1	Plastic- Rubber Maid Trash Can - 32 Gallons	6	6	Black Stripe
15	Billet	1	Plastic- Rubber Maid Trash Can - 32 Gallons	6	6	Black Stripe
16	Billet	1	Plastic- Rubber Maid Trash Can - 32 Gallons	6	6	Black Stripe
17	Billet	1	Plastic- Rubber Maid Trash Can - 32 Gallons	6	6	Black Stripe
18	Billet	1	Plastic- Rubber Maid Trash Can - 32 Gallons	6	6	Black Stripe
19	Billet	1	Plastic- Rubber Maid Trash Can - 32 Gallons	6	6	Black Stripe
20	Billet	1	Plastic- Rubber Maid Trash Can - 32 Gallons	6	6	Black Stripe
21	Billet	1	Plastic- Rubber Maid Trash Can - 32 Gallons	6	6	Black Stripe
22	Billet	1	Plastic- Rubber Maid Trash Can - 32 Gallons	6	6	Black Stripe
23	Billet	1	Plastic- Rubber Maid Trash Can - 32 Gallons	6	6	Black Stripe
24	Billet	1	Plastic- Rubber Maid Trash Can - 32 Gallons	6	6	Black Stripe
25	Billet	1	Plastic- Rubber Maid Trash Can - 32 Gallons	6	6	Black Stripe
26	Billet	1	Plastic- Rubber Maid Trash Can - 32 Gallons	6	6	Black Stripe
27	Billet	1	Plastic- Rubber Maid Trash Can - 32 Gallons	6	6	Black Stripe
28	Billet	1	Plastic- Rubber Maid Trash Can - 32 Gallons	6	6	Black Stripe
29	Billet	1	Plastic- Rubber Maid Trash Can - 32 Gallons	6	6	Black Stripe
30	Billet	1	Plastic- Rubber Maid Trash Can - 32 Gallons	6	6	Black Stripe
31	Billet	1	Plastic- Rubber Maid Trash Can - 32 Gallons	6	6	Black Stripe
32	Billet	1	Plastic- Rubber Maid Trash Can - 32 Gallons	6	6	Black Stripe
33	Billet	1	Plastic- Rubber Maid Trash Can - 32 Gallons	6	6	Black Stripe
34	Billet	1	Plastic- Rubber Maid Trash Can - 32 Gallons	6	6	Black Stripe
35	Billet	1	Plastic- Rubber Maid Trash Can - 32 Gallons	6	6	Black Stripe
36	Billet	1	Plastic- Rubber Maid Trash Can - 32 Gallons	6	6	Black Stripe
37	Billet	1	Plastic- Rubber Maid Trash Can - 32 Gallons	6	6	Black Stripe
38	Billet	1	Plastic- Rubber Maid Trash Can - 32 Gallons	6	6	Black Stripe
39	Billet	1	Plastic- Rubber Maid Trash Can - 32 Gallons	6	6	Black Stripe
40	Billet	1	Plastic- Rubber Maid Trash Can - 32 Gallons	6	6	Black Stripe

FORCE PROVIDER TENT AND TRASH CAN INVENTORY (cont.)

Tent Number	Facility Type	# of Trash Cans	Type of Trash Can	Trash Bags/ Study	Total Required	Marking
41	Admin	1	Plastic- Rubber Maid Trash Can - 32 Gallons	6	6	Black Bag
42	Admin	1	Plastic- Rubber Maid Trash Can - 32 Gallons	6	6	Black Bag
43	First Aid Station	1	Plastic- Rubber Maid Trash Can - 32 Gallons	6	6	Black Bag
44	Chapel	0		6	0	Black Bag
45	Admin	1	Plastic- Rubber Maid Trash Can - 32 Gallons	6	6	Black Bag
46	Admin	1	Plastic- Rubber Maid Trash Can - 32 Gallons	6	6	Black Bag
47	Admin	1	Plastic- Rubber Maid Trash Can - 32 Gallons	6	6	Black Bag
48	Admin	1	Plastic- Rubber Maid Trash Can - 32 Gallons	6	6	Black Bag
49	Rec Room	1	Plastic- Rubber Maid Trash Can - 32 Gallons	6	6	Black Bag
50	Gym	2	Plastic- Rubber Maid Trash Can - 32 Gallons	6	12	Black Bag
51	Dining Facility- Seating	2	Galvanized	30	60	Blue Stripe
52	Dining Facility - Serving Line/ Food Prep	0			0	Blue Stripe
53	Dining Facility- Food Prep	0			0	Blue Stripe
54	Dining Facility - Sanitization	10	Galvanized	15	150	Blue Stripe
55	Latrine	1	Metal (10 gal?)	6	6	Green Stripe
56	Latrine	1	Metal (10 gal?)	6	6	Green Stripe
57	Shower	1	Plastic- Rubber Maid Trash Can - 32 Gallons	6	6	Green Stripe
58	Latrine	1	Metal (10 gal?)	6	6	Green Stripe
59	Shower	1	Plastic- Rubber Maid Trash Can - 32 Gallons	6	6	Green Stripe
60	Potable Water	0		6	0	Green Stripe
61	Laundry	1	Plastic- Rubber Maid Trash Can - 32 Gallons	6	6	Green Stripe
62	Latrine	1	Metal (10 gal?)	6	6	Green Stripe
63	Maintenance Tent	0		6	0	Green Stripe

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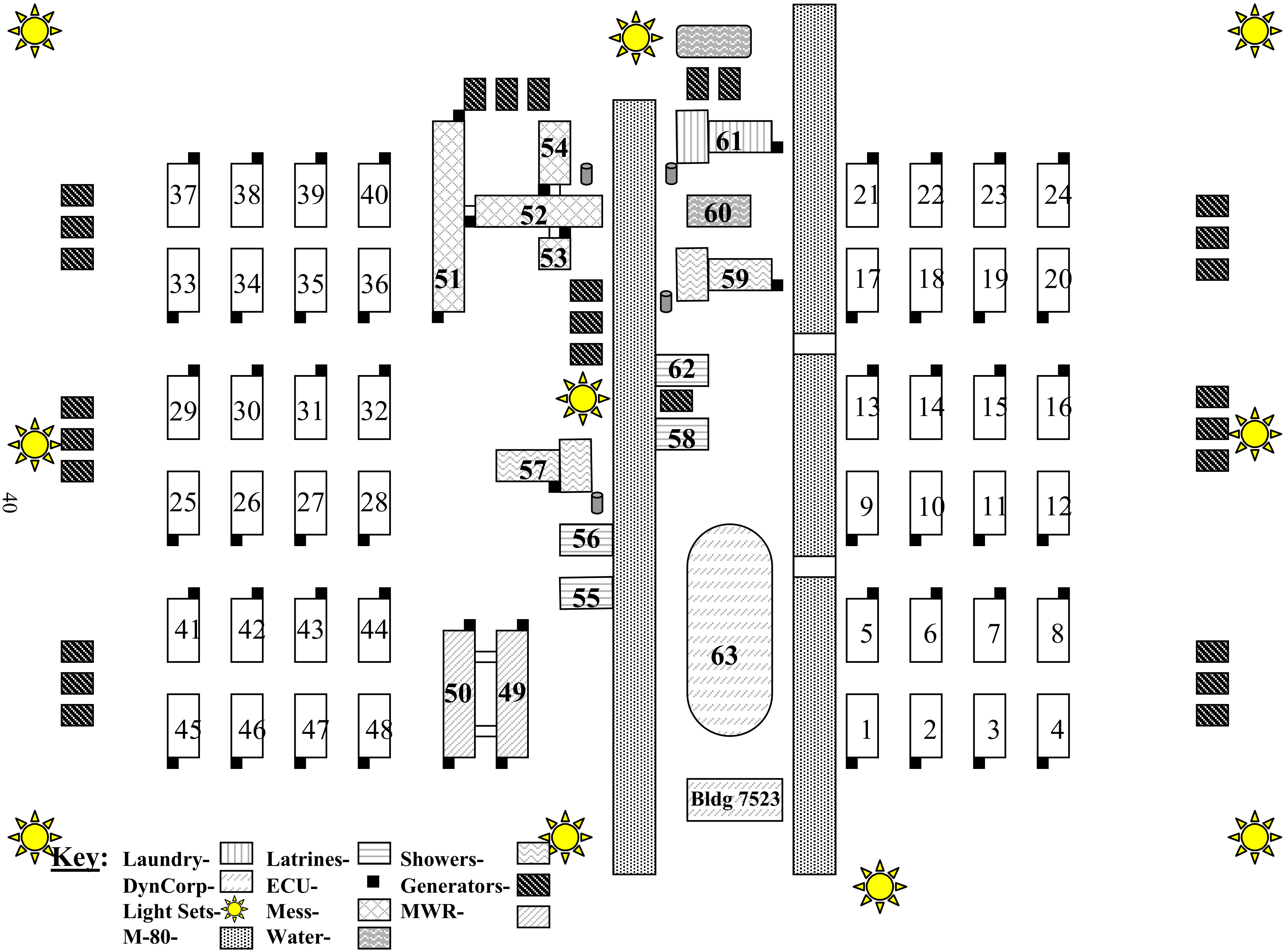
APPENDIX B – MAP OF FORCE PROVIDER SITE



1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48
49 50 51 52 53 54 55 56 57 58 59 60 61 62 63
Bldg 7523
Key:
Laundry-
DynCorp-
Light Sets-
M-80-
Latrines-
ECU-
Mess-
Water-
Showers-
Generators-
MWR-

APPENDIX C – JRTC WASTE RAW DATA

----- Original Message -----
From: Hull, Christine Ms DPW
To: Bill Ruppert ; Hull, Christine Ms DPW
Cc: Hardwick, Jack Contractor
Sent: Tuesday, May 30, 2000 11:22 AM
Subject: RE: 8300 Refuse

FYI see below

-----Original Message-----
From: Nelson Paul M MAJ OPSGRP P/EMC G1/G4
Sent: Tuesday, May 30, 2000 11:18 AM
To: Hull, Christine Ms DPW
Subject: RE: 8300 Refuse

Christine,
Keep in mind these are rough guesstimates:
Nov 99 - 4600 persons
Jan 00 - 5000 persons
Feb 00 - 3900 persons
Apr 00 - 3500 persons
Hope this helps,
Paul

-----Original Message-----
From: Hull, Christine Ms DPW
Sent: Tuesday, May 30, 2000 8:23 AM

Christine Hull, Ph.D.
Installation Hazardous Waste & Hazardous Materials Manager
JRTC & Fort Polk
Fort Polk, LA 71459
DSN: 863-6084
Comm: 337-531-6084

----- Original Message -----
From: Hardwick, Jack Contractor
To: Wruppert
Sent: Friday, May 26, 2000 11:45 AM
Subject: FW: 8300 Rerfuse

Here is info you asked for from Christine.

-----Original Message-----
From: Hull, Christine Ms DPW
Sent: Friday, May 26, 2000 10:10 AM
To: Hardwick, Jack Contractor
Subject: FW: 8300 Refuse

Jack,

Could you pass this data to the folks from Hughes? The middle column is the tons of solid waste (trash) from the rotational box in those months (of course, no rotation in Dec, so the numbers are very low and reflect local training).

Date	Tons from Consolidated Solid Waste Point	Total Installation Refuse
Nov 99	143.32	1081.71
Dec 99	10.46	1143.63
Jan 00	97.19	999.32
Feb 00	100.07	1070.23
Mar 00	77.41	1062.55
April 00	133.81	1081.73

Christine Hull, Ph.D.
Installation Hazardous Waste & Hazardous Materials Manager
JRTC & Fort Polk
Fort Polk, LA 71459
DSN: 863-6084
Comm: 337-531-6084

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APPENDIX D – DAILY STATUS SHEETS

691st Quartermaster Company

DATE: 19-Jun-00

LIQUIDS	AMOUNT ON HAND	WATER ON HAND (USED)	AMOUNT USED TODAY	CUMULATIVE USE – 691ST	CUMULATIVE USE – 542ND
FUEL (DRUMS)	217 gal		3 gal	15 gal	32 gal
WATER (BAGS)	15,000 gal		13,200 gal	55,750 gal	72,100 gal

SERVICES		SOLDIERS DAILY USE	CUMULATIVE USE – 691ST	CUMULATIVE USE – TOTAL
	LAUNDRY	630 #	3405 #	4940 #
	SHOWERS	121	480	1,235
DINING FACILITY	BREAKFAST	150	721	1,173
	LUNCH	57	150	400
	DINNER	115	701	1,088

LOGISTICS/ MAINTENANCE

ITEM	NUMBER ON HAND	FULL MISSION CAPABLE	NON-MISSION CAPABLE	REMARKS
64 ' TEMPER TENTS	4	4	0	
32' TEMPER TENTS	48	44	4	
ECU'S	57	53	4	2 Need Repair, 2 down (parts)
M-80 WATER HEATER	4	4	0	
WATER PUMPS	2	2	0	
WINDOW A/C UNITS	4	4	0	
LIGHT TOWERS	10	10	0	
WATER BUFFALO'S	2	2	0	
GSA VAN	1	1	0	
GSA PICK-UP	1	1	0	
GATOR	1	1	0	
CONTAINERIZED SHOWER	2	2	0	
CONTAINERIZED BATCH LAUNDRY	1	1	0	
CONTAINERIZED LATRINE	4	4	0	

PERSONNEL	Host Soldiers on Site	Attached Soldiers on Site	Customer Soldiers on Site
	31	26	108

MAJOR TRAINING EVENTS	52C trained on generator set-up; operation. 77W trained on set-up and operation of SMFT.

691st Quartermaster Company

DATE: 20 Jun 00

LIQUIDS	AMOUNT ON HAND	WATER ON HAND (USED)	AMOUNT USED TODAY	CUMULATIVE USE – 691ST	CUMULATIVE USE – 542ND
FUEL (DRUMS)	214 gal		3 gal	18 gal	32 gal
WATER (BAGS)	15,000 gal		8,600 gal	64,350 gal	72,100 gal

SERVICES		SOLDIERS DAILY USE	CUMULATIVE USE – 691ST	CUMULATIVE USE – TOTAL
	LAUNDRY	590 #	3995 #	4940 #
	SHOWERS	153	633	1,235
DINING FACILITY	BREAKFAST	136	857	1,173
	LUNCH	57	207	400
	DINNER	160	861	1,088

LOGISTICS/ MAINTENANCE

ITEM	NUMBER ON HAND	FULL MISSION	NON-MISSION CAPABLE	REMARKS
64' TEMPER TENTS	4	4	0	
32' TEMPER TENTS	48	44	4	
ECUs	57	53	4	2 Need Repair, 2 down (parts)
M-80 WATER HEATER	4	3	1	1 Fuel Drum contaminated (water)
WATER PUMPS	2	2	0	
WINDOW A/C UNITS	4	4	0	
LIGHT TOWERS	10	10	0	
WATER BUFFALO'S	2	2	0	
GSA VAN	1	1	0	
GSA PICK-UP	1	1	0	
GATOR	1	1	0	
CONTAINERIZED SHOWER	2	2	0	
CONTAINERIZED BATCH LAUNDRY	1	1	0	
CONTAINERIZED LATRINE	4	4	0	

PERSONNEL	Host Soldiers on Site	Attached Soldiers on Site	Customer Soldiers on Site
	31	26	108

MAJOR TRAINING EVENTS	
	Power Generator Cluster Training Hyper Chlorinator Training

691st Quartermaster Company

DATE: 21 Jun 00

LIQUIDS	AMOUNT ON HAND	WATER ON HAND (USED)	AMOUNT USED TODAY	CUMULATIVE USE – 691ST	CUMULATIVE USE – 542ND
FUEL (DRUMS) gal	211 gal		3	21	32
WATER (BAGS) gal	15,000 gal		8,800	65,750	72,100

SERVICES		SOLDIERS DAILY USE	CUMULATIVE USE – 691ST	CUMULATIVE USE -- TOTAL
	LAUNDRY (lbs)	740	4,735	4,940
	SHOWERS	158	791	1,235
DINING FACILITY	BREAKFAST	140	997	1,173
	LUNCH	57	264	400
	DINNER	160	1,021	1,088

LOGISTICS/ MAINTENANCE

ITEM	NUMBER ON HAND	FULL MISSION CAPABLE	NON-MISSION CAPABLE	REMARKS
64' TEMPER TENTS	4	4	0	
32' TEMPER TENTS	48	44	4	
ECUs	57	53	4	2 Need Repair, 2 down (parts)
M-80 WATER HEATER	4	4	0	
WATER PUMPS	2	2	0	
WINDOW A/C UNITS	4	4	0	
LIGHT TOWERS	10	10	0	
WATER BUFFALO'S	2	2	0	
GSA VAN	1	1	0	
GSA PICK-UP	1	1	0	
GATOR	1	1	0	
CONTAINERIZED SHOWER	2	2	0	
CONTAINERIZED BATCH LAUNDRY	1	1	0	
CONTAINERIZED LATRINE	4	4	0	

PERSONNEL	Host Soldiers on Site	Attached Soldiers on Site	Customer Soldiers on Site
	31	26	108

MAJOR TRAINING EVENTS	Laundry section trained on Maintaining Containerized Batch Laundry. Maintenance section trained on ECU and M80 Heater maintenance and repair. Water section trained on water chlorination.

691st Quartermaster Company

DATE: 22 Jun 00

LIQUIDS	AMOUNT ON HAND	WATER ON HAND (USED)	AMOUNT USED TODAY	CUMULATIVE USE – 691ST	CUMULATIVE USE – 542ND
FUEL (DRUMS) gal	208 gal		3	24	32
WATER (BAGS) gal	15,000 gal		7,200	72,950	72,100

SERVICES		SOLDIERS DAILY USE	CUMULATIVE USE -- 691ST	CUMULATIVE USE -- TOTAL
	LAUNDRY (lbs)	420	5,155	4,940
	SHOWERS	153	944	1,235
DINING FACILITY	BREAKFAST	150	997	1,173
	LUNCH	63	327	400
	DINNER	168	1,189	1,088

LOGISTICS/ MAINTENANCE

ITEM	NUMBER ON HAND	FULL MISSION CAPABLE	NON-MISSION CAPABLE	REMARKS
64' TEMPER TENTS	4	4	0	
32' TEMPER TENTS	48	44	4	
ECUs	57	54	3	1 Needs Repair, 2 down (parts)
M-80 WATER HEATER	4	4	0	
WATER PUMPS	2	2	0	
WINDOW A/C UNITS	4	4	0	
LIGHT TOWERS	10	10	0	
WATER BUFFALO'S	2	2	0	
GSA VAN	1	1	0	
GSA PICK-UP	1	1	0	
GATOR	1	1	0	
CONTAINERIZED SHOWER	2	2	0	
CONTAINERIZED BATCH LAUNDRY	1	1	0	
CONTAINERIZED LATRINE	4	4	0	

PERSONNEL	Host Soldiers on Site	Attached Soldiers on Site	Customer Soldiers on Site	Visitors on Site
	31	26	108	6

MAJOR TRAINING EVENTS	Selected personnel trained on maintenance and operation of M80 Water Heater. Selected personnel trained on Bulk Fuel Storage and Distribution for FP Module.

691st Quartermaster Company

DATE: 24 Jun 00

LIQUIDS	AMOUNT ON HAND	WATER ON HAND (USED)	AMOUNT USED TODAY	CUMULATIVE USE – 691ST	CUMULATIVE USE – 542ND
FUEL (DRUMS) gal	201 gal		4	25	32
WATER (BAGS) gal	15,000 gal		7,800	93,150	72,100

SERVICES		SOLDIERS DAILY USE	CUMULATIVE USE – 691ST	CUMULATIVE USE – TOTAL
	LAUNDRY (lbs)	500	6,375	4,940
	SHOWERS	146	1,166	1,235
DINING FACILITY	BREAKFAST	111	1,253	1,173
	LUNCH	63	453	400
	DINNER	109	1,460	1,088

LOGISTICS/ MAINTENANCE

ITEM	NUMBER ON HAND	FULL MISSION CAPABLE	NON-MISSION CAPABLE	REMARKS
64' TEMPER TENTS	4	4	0	
32' TEMPER TENTS	48	44	4	No ECUs
ECUs	57	55	2	2 down (parts)
M-80 WATER HEATER	4	4	0	
WATER PUMPS	2	2	0	
WINDOW A/C UNITS	4	4	0	
LIGHT TOWERS	10	9	1	1 inop / 5 with some lights out
WATER BUFFALO'S	2	2	0	
GSA VAN	1	1	0	
GSA PICK-UP	1	1	0	
GATOR	1	1	0	
CONTAINERIZED SHOWER	2	2	0	
CONTAINERIZED BATCH LAUNDRY	1	1	0	30 min down time due to over heated dryer.
CONTAINERIZED LATRINE	4	4	0	

PERSONNEL	Host Soldiers on Site	Attached Soldiers on Site	Customer Soldiers on Site	Visitors on Site
	31	3	108	3

MAJOR TRAINING EVENTS	Selected personnel trained on Land Navigation (Compass Course). Maintenance section trained on setup/operate and dismantle Floodlight Set Crew Drills.

APPENDIX E – RAW TRASH AND KITCHEN WASTE DATA

Data Key	Date Waste Produced	Date Material Analyzed	Time	Recorder	Waste Type	Weight (lb.)	Dimensions w	l	h	Volume (cu. Ft.)	Density lb/ft3	Source	Meal	Military/ Non-Military	Ref. Sheet#	Heating Value BTU/lb.	Notes
1	18-Jun-00	19-Jun-00	4:30 PM	JAG	15	0.6	12	12	8	0.667	0.900	Admin		Non-Military	1	20043	
2	18-Jun-00	19-Jun-00	4:30 PM	JAG	17	1.2	15	15	13	1.693	0.709	Admin		Military	1	17111	
3	18-Jun-00	19-Jun-00	4:30 PM	JAG	4	2.7	15	15	3	0.391	6.912	Admin		Military	1	2370	
4	18-Jun-00	19-Jun-00	4:30 PM	JAG	1	4.3	16	16	20	2.963	1.451	Admin		Non-Military	1	7370	
5	18-Jun-00	19-Jun-00	4:30 PM	JAG	7	0.3	9	8	5	0.208	1.440	Admin		Non-Military	1	13378	
6	18-Jun-00	19-Jun-00	4:30 PM	JAG	10	0.4	8	10	4	0.185	2.160	Admin		Military	1	7370	
7	18-Jun-00	19-Jun-00	4:30 PM	JAG	13	0.5	9	9	3	0.141	3.556	Admin		Military	1	9267	
8	18-Jun-00	19-Jun-00	4:30 PM	JAG	14	0.1	7	5	2	0.041	2.469	Admin		Non-Military	1	9560	
9	18-Jun-00	19-Jun-00	4:30 PM	JAG	21	0.05	6	5	2	0.035	1.440	Admin		Military	1	10275	
10	18-Jun-00	19-Jun-00	4:30 PM	JAG	10	1.662407495	15	15	5	0.651	2.553	Bath		Military	1	7370	Most of actual weight was from water so the weight is found by taking the volume and multiplying it by the calculated average material 10 density
11	18-Jun-00	19-Jun-00	4:30 PM	JAG	4	0.2	3	6	1	0.010	19.200	Bath		Military	1	2370	
12	18-Jun-00	19-Jun-00	4:30 PM	JAG	10	5	28	18	13	3.792	1.319	Bath		Military	1	7370	
13	18-Jun-00	19-Jun-00	4:30 PM	JAG	15	0.3	11	12	6	0.458	0.655	Bath		Military	1	20043	
14	18-Jun-00	19-Jun-00	4:30 PM	JAG	7	0.2	5	5	5	0.072	2.765	Bath		Non-Military	1	13378	
15	18-Jun-00	19-Jun-00	4:30 PM	JAG	14	0.05	0	0	0	0.013	3.733	Bath		Military	1	9560	Volume found by taking the weight and dividing it by the calcualted average material 14 density
16	18-Jun-00	19-Jun-00	4:30 PM	JAG	13	0.1	4	4	3	0.028	3.600	Bath		Military	1	9267	
17	18-Jun-00	19-Jun-00	4:30 PM	JAG	15	3.4	20	20	12	2.778	1.224	Billet		Military	1	20043	
18	18-Jun-00	19-Jun-00	4:30 PM	JAG	4	17.3	18	17	12	2.125	8.141	Billet		Military	1	2370	
19	18-Jun-00	19-Jun-00	4:30 PM	JAG	21	5	21	17	12	2.479	2.017	Billet		Military	1	10275	
20	18-Jun-00	19-Jun-00	4:30 PM	JAG	7	4	15	17	14	2.066	1.936	Billet		Non-Military	1	13378	
21	18-Jun-00	19-Jun-00	4:30 PM	JAG	15	6	25	19	20	5.498	1.091	Billet		Non-Military	1	20043	
22	18-Jun-00	19-Jun-00	4:30 PM	JAG	10	7.6	19	10	16	1.759	4.320	Billet		Military	1	7370	
23	18-Jun-00	19-Jun-00	4:30 PM	JAG	22	0.5	10	1	3	0.017	28.800	Billet		Military	1	7866	
24	18-Jun-00	19-Jun-00	4:30 PM	JAG	19	10.5	20	17	9	1.771	5.929	Billet		Military	1	5458	
25	18-Jun-00	19-Jun-00	4:30 PM	JAG	13	6.8	17	18	20	3.542	1.920	Billet		Military	1	9267	
26	18-Jun-00	19-Jun-00	4:30 PM	JAG	17	1	17	17	17	2.843	0.352	Billet		Military	1	17111	
27	18-Jun-00	19-Jun-00	4:30 PM	JAG	1	6.1	24	14	17	3.306	1.845	Billet		Military	1	7370	Most of weight from water
28															2		Sheet 2 is notes only - no data
29	18-Jun-00	19-Jun-00	4:30 PM	JAG	14	1.8	13	14	7	0.737	2.441	Billet		Military	3	9560	
30	18-Jun-00	19-Jun-00	4:30 PM	JAG	5	1.4	6	9	3	0.094	14.933	Billet		Non-Military	3	0	
31	18-Jun-00	19-Jun-00	4:30 PM	JAG	23	0.7	9	8	3	0.125	5.600	Billet		Military	3	11019	
32	18-Jun-00	19-Jun-00	4:30 PM	JAG	24	0.5	3	3	1	0.005	96.000	Billet		Military	3	9910	
33	18-Jun-00	19-Jun-00	4:30 PM	JAG	8	0.4	0	0	0	0.004	104.640	Billet		Military	3	3185	Volume found by taking the weight and dividing it by the calcualted average material 8 density
34	18-Jun-00	19-Jun-00	4:30 PM	JAG	3	0.2	0	0	0	0.032	6.267	Billet		Military	3	7974	Volume found by taking the weight and dividing it by the calculated average material 3 density
35	18-Jun-00	19-Jun-00	4:30 PM	JAG	25	0.1	0	0	0	0.019	5.184	Billet		Military	3	13663	Voume found by taking the weight and dividing it by the only found material 25 density
36	18-Jun-00	19-Jun-00	4:30 PM	JAG	26	0.1	0	0	0	0.150	172.800	Billet		Military	3	0	Volume found by taking the weight and dividing it by the one material 26 density found.
37	18-Jun-00	19-Jun-00	4:30 PM	JAG	27	0.1	0	0	0	0.001	149.760	Billet		Military	3	1403	Volume found by taking the weight and dividing it by the calculated average material 27 density
38	18-Jun-00				Additional Dumpster Volume Not Weighed	227.28	18	72	82	61.500	3.696	Food Service				227	Weight calculated by finding the average dumpster dentsity, using measured dumpster weights/volumes, and multipling it by the volume
39	18-Jun-00				Dumpster Volume Weighed		41	72	82			Food Service	140.083				This volume is the total volume of trash in the dumpster minus the additional dumpster volume not weighed(Total voulme was 59"x72"x82")
40	18-Jun-00	19-Jun-00	7:00 PM	JAG	40	26.7	0	0	0	6.614	4.037	Food Service	All Meals	Military	3	6710	Time recorded is an estimated starting time. Volume found by taking the weight and dividing it by the calculated average material 40 density
41	18-Jun-00	19-Jun-00	7:00 PM	JAG	40	4.5	0	0	0	1.115	4.037	Food Service	All Meals	Military	3	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density
42	18-Jun-00	19-Jun-00	7:00 PM	JAG	40	9.3	0	0	0	2.304	4.037	Food Service	All Meals	Military	3	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density

Data Key	Date Waste Produced	Date Material Analyzed	Time	Recorder	Waste Type	Weight (lb.)	Dimensions w	l	h	Volume (cu. Ft.)	Density lb/ft3	Source	Meal	Military/ Non-Military	Ref. Sheet#	Heating Value BTU/lb.	Notes
43	18-Jun-00	19-Jun-00	7:00 PM	JAG	40	12.5	0	0	0	3.096	4.037	Food Service	All Meals	Military	3	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density
44	18-Jun-00	19-Jun-00	7:00 PM	JAG	1	3.8	0	0	0	1.528	2.488	Food Service	All Meals	Military	3	7370	Volume found by taking the weight and dividing it by the calculated average material 1 density
45	18-Jun-00	19-Jun-00	7:00 PM	JAG	4a	28.8	0	0	0	0.766	37.601	Food Service	All Meals	Military	3	1000	Volume found by taking the weight and dividing it by the calculated average material 4a density
46	18-Jun-00	19-Jun-00	7:00 PM	JAG	17	11	0	0	0	12.057	0.912	Food Service	All Meals	Military	3	17111	Volume found by taking the weight and dividing it by the calculated material 17 density.
47	18-Jun-00	19-Jun-00	7:00 PM	JAG	40	12.8	0	0	0	3.171	4.037	Food Service	All Meals	Military	3	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density
48	18-Jun-00	19-Jun-00	7:00 PM	JAG	4a	13.3	0	0	0	0.354	37.601	Food Service	All Meals	Military	3	1000	Volume found by taking the weight and dividing it by the calculated average material 4a density
49	18-Jun-00	19-Jun-00	7:00 PM	JAG	40	9.5	0	0	0	2.353	4.037	Food Service	All Meals	Military	3	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density
50	18-Jun-00	19-Jun-00	7:00 PM	JAG	4a	25.3	0	0	0	0.673	37.601	Food Service	All Meals	Military	3	1000	Volume found by taking the weight and dividing it by the calculated average material 4a density
51	18-Jun-00	19-Jun-00	7:00 PM	JAG	4a	7.1	0	0	0	0.189	37.601	Food Service	All Meals	Military	3	1000	Volume found by taking the weight and dividing it by the calculated average material 4a density
52	18-Jun-00	19-Jun-00	7:00 PM	JAG	1	5.2	0	0	0	2.090	2.488	Food Service	All Meals	Military	3	7370	Volume found by taking the weight and dividing it by the calculated average material 1 density
53	18-Jun-00	19-Jun-00	7:00 PM	JAG	40	12.6	0	0	0	3.121	4.037	Food Service	All Meals	Military	3	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density
54	18-Jun-00	19-Jun-00	7:00 PM	JAG	4a	38.5	0	0	0	1.024	37.601	Food Service	All Meals	Military	3	1000	Volume found by taking the weight and dividing it by the calculated average material 4a density
55	18-Jun-00	19-Jun-00	7:00 PM	JAG	4a	12.2	0	0	0	0.324	37.601	Food Service	All Meals	Military	3	1000	Volume found by taking the weight and dividing it by the calculated average material 4a density
56	18-Jun-00	19-Jun-00	7:00 PM	JAG	1	4.6	0	0	0	1.849	2.488	Food Service	All Meals	Military	3	7370	Volume found by taking the weight and dividing it by the calculated average material 1 density
57	18-Jun-00	19-Jun-00	7:00 PM	JAG	1	4.8	0	0	0	1.930	2.488	Food Service	All Meals	Military	3	7370	Volume found by taking the weight and dividing it by the calculated average material 1 density
58	18-Jun-00	19-Jun-00	7:00 PM	JAG	40	9.3	0	0	0	2.304	4.037	Food Service	All Meals	Military	3	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density
59	18-Jun-00	19-Jun-00	7:00 PM	JAG	40	10.2	0	0	0	2.527	4.037	Food Service	All Meals	Military	4	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density
60	18-Jun-00	19-Jun-00	7:00 PM	JAG	1	8.2	0	0	0	3.296	2.488	Food Service	All Meals	Military	4	7370	Volume found by taking the weight and dividing it by the calculated average material 1 density
61	18-Jun-00	19-Jun-00	7:00 PM	JAG	40	21.4	0	0	0	5.301	4.037	Food Service	All Meals	Military	4	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density
62	18-Jun-00	19-Jun-00	7:00 PM	JAG	40	9.8	0	0	0	2.427	4.037	Food Service	All Meals	Military	4	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density
63	18-Jun-00	19-Jun-00	7:00 PM	JAG	40	7.3	0	0	0	1.808	4.037	Food Service	All Meals	Military	4	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density
64	18-Jun-00	19-Jun-00	7:00 PM	JAG	40	22.1	0	0	0	5.474	4.037	Food Service	All Meals	Military	4	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density
65	18-Jun-00	19-Jun-00	7:00 PM	JAG	40	12.1	0	0	0	2.997	4.037	Food Service	All Meals	Military	4	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density
66	18-Jun-00	19-Jun-00	7:00 PM	JAG	40	12.6	0	0	0	3.121	4.037	Food Service	All Meals	Military	4	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density
67	18-Jun-00	19-Jun-00	7:00 PM	JAG	40	23.8	0	0	0	5.895	4.037	Food Service	All Meals	Military	4	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density
68	18-Jun-00	19-Jun-00	7:00 PM	JAG	1	9.4	0	0	0	3.779	2.488	Food Service	All Meals	Military	4	7370	Volume found by taking the weight and dividing it by the calculated average material 1 density
69	18-Jun-00	19-Jun-00	7:00 PM	JAG	1	3.3	0	0	0	1.327	2.488	Food Service	All Meals	Military	4	7370	Volume found by taking the weight and dividing it by the calculated average material 1 density
70	18-Jun-00	19-Jun-00	7:00 PM	JAG	40	15.3	0	0	0	3.790	4.037	Food Service	All Meals	Military	4	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density
71	18-Jun-00	19-Jun-00	7:00 PM	JAG	40	14.7	0	0	0	3.641	4.037	Food Service	All Meals	Military	4	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density
72	18-Jun-00	19-Jun-00	7:00 PM	JAG	40	16.5	0	0	0	4.087	4.037	Food Service	All Meals	Military	4	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density

Data Key	Date Waste Produced	Date Material Analyzed	Time	Recorder	Waste Type	Weight (lb.)	Dimensions w	l	h	Volume (cu. Ft.)	Density lb/ft3	Source	Meal	Military/ Non-Military	Ref. Sheet#	Heating Value BTU/lb.	Notes
73	18-Jun-00	19-Jun-00	7:00 PM	JAG	40	12.5	0	0	0	3.096	4.037	Food Service	All Meals	Military	4	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density
74	18-Jun-00	19-Jun-00	7:00 PM	JAG	40	2.8	0	0	0	0.694	4.037	Food Service	All Meals	Military	4	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density
75	18-Jun-00	19-Jun-00	7:00 PM	JAG	40	29.3	0	0	0	7.258	4.037	Food Service	All Meals	Military	4	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density
76	18-Jun-00	19-Jun-00	7:00 PM	JAG	21	6.7	0	0	0	2.140	3.130	Food Service	All Meals	Military	4	10275	Volume found by taking the weight and dividing it by the calculated average material 21 density
77	18-Jun-00	19-Jun-00	7:00 PM	JAG	40	6.1	0	0	0	1.511	4.037	Food Service	All Meals	Military	4	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density
78	18-Jun-00	19-Jun-00	7:00 PM	JAG	1	7.4	0	0	0	2.975	2.488	Food Service	All Meals	Military	4	7370	Volume found by taking the weight and dividing it by the calculated average material 1 density
79	18-Jun-00	19-Jun-00	7:00 PM	JAG	1	14.4	0	0	0	5.789	2.488	Food Service	All Meals	Military	4	7370	Volume found by taking the weight and dividing it by the calculated average material 1 density
80	19-Jun-00				Total Dumpster Volume for 6/19/00		48	72	82		2.732	Food Service	164.000				
81	19-Jun-00	19-Jun-00	7:00 PM	JAG	1	13.9	0	0	0	5.588	2.488	Food Service	All Meals	Military	5	7370	Volume found by taking the weight and dividing it by the calculated average material 1 density
82	19-Jun-00	19-Jun-00	7:00 PM	JAG	40	13.4	0	0	0	3.319	4.037	Food Service	All Meals	Military	5	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density
83	19-Jun-00	19-Jun-00	7:00 PM	JAG	4a	14.7	0	0	0	0.391	37.601	Food Service	All Meals	Military	5	1000	Volume found by taking the weight and dividing it by the calculated average material 4a density
84	19-Jun-00	19-Jun-00	7:00 PM	JAG	40	11.5	0	0	0	2.849	4.037	Food Service	All Meals	Military	5	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density
85	19-Jun-00	19-Jun-00	7:00 PM	JAG	1	4.1	0	0	0	1.648	2.488	Food Service	All Meals	Military	5	7370	Volume found by taking the weight and dividing it by the calculated average material 1 density
86	19-Jun-00	19-Jun-00	7:00 PM	JAG	10	10.2	0	0	0	0.000	2.553	Food Service	All Meals	Military	5	7370	Volume found by taking the weight and dividing it by the calculated average material 10 density
87	19-Jun-00	19-Jun-00	7:00 PM	JAG	40	14.4	0	0	0	3.567	4.037	Food Service	All Meals	Military	5	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density
88	19-Jun-00	19-Jun-00	7:00 PM	JAG	40	5.5	0	0	0	1.362	4.037	Food Service	All Meals	Military	5	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density
89	19-Jun-00	19-Jun-00	7:00 PM	JAG	40	9.2	0	0	0	2.279	4.037	Food Service	All Meals	Military	5	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density
90	19-Jun-00	19-Jun-00	7:00 PM	JAG	4a	29.8	0	0	0	0.793	37.601	Food Service	All Meals	Military	5	1000	Volume found by taking the weight and dividing it by the calculated average material 4a density
91	19-Jun-00	19-Jun-00	7:00 PM	JAG	1	6.1	0	0	0	2.452	2.488	Food Service	All Meals	Military	5	7370	Volume found by taking the weight and dividing it by the calculated average material 1 density
92	19-Jun-00	19-Jun-00	7:00 PM	JAG	40	10.5	0	0	0	2.601	4.037	Food Service	All Meals	Military	5	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density
93	19-Jun-00	19-Jun-00	7:00 PM	JAG	40	12.8	0	0	0	3.171	4.037	Food Service	All Meals	Military	5	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density
94	19-Jun-00	19-Jun-00	7:00 PM	JAG	40	11.9	0	0	0	2.948	4.037	Food Service	All Meals	Military	5	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density
95	19-Jun-00	19-Jun-00	7:00 PM	JAG	1	6.7	0	0	0	2.693	2.488	Food Service	All Meals	Military	5	7370	Volume found by taking the weight and dividing it by the calculated average material 1 density
96	19-Jun-00	19-Jun-00	7:00 PM	JAG	1	6	0	0	0	2.412	2.488	Food Service	All Meals	Military	5	7370	Volume found by taking the weight and dividing it by the calculated average material 1 density
97	19-Jun-00	19-Jun-00	7:00 PM	JAG	1	7.1	0	0	0	2.854	2.488	Food Service	All Meals	Military	5	7370	Volume found by taking the weight and dividing it by the calculated average material 1 density
98	19-Jun-00	19-Jun-00	7:00 PM	JAG	1	11.1	0	0	0	4.462	2.488	Food Service	All Meals	Military	5	7370	Volume found by taking the weight and dividing it by the calculated average material 1 density
99	19-Jun-00	19-Jun-00	7:00 PM	JAG	1	5.2	0	0	0	2.090	2.488	Food Service	All Meals	Military	5	7370	Volume found by taking the weight and dividing it by the calculated average material 1 density
100	19-Jun-00	19-Jun-00	7:00 PM	JAG	15	6.1	0	0	0	3.203	1.904	Food Service	All Meals	Military	5	20043	Volume found by taking the weight and dividing it by the calculated average material 15 density.
101	19-Jun-00	19-Jun-00	7:00 PM	JAG	10	1.2	0	0	0	0.470	2.553	Food Service	All Meals	Military	5	7370	Volume found by taking the weight and dividing it by the calculated average material 10 density

Data Key	Date Waste Produced	Date Material Analyzed	Time	Recorder	Waste Type	Weight (lb.)	Dimensions			Volume (cu. Ft.)	Density lb/ft3	Source	Meal	Military/ Non-Military	Ref. Sheet#	Heating Value BTU/lb.	Notes
							w	l	h								
102	19-Jun-00	19-Jun-00	7:00 PM	JAG	13	0.7	0	0	0	0.314	2.229	Food Service	All Meals	Military	5	9267	Volume found by taking the weight and dividing it by the calculated average material 13 density.
103	19-Jun-00	19-Jun-00	7:00 PM	JAG	40	9.8	0	0	0	2.427	4.037	Food Service	All Meals	Military	5	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density
104	19-Jun-00	19-Jun-00	7:00 PM	JAG	21	16.2	0	0	0	5.175	3.130	Food Service	All Meals	Military	5	10275	Volume found by taking the weight and dividing it by the calculated average material 21 density
105	19-Jun-00	19-Jun-00	7:00 PM	JAG	21	15.8	0	0	0	5.047	3.130	Food Service	All Meals	Military	5	10275	Volume found by taking the weight and dividing it by the calculated average material 21 density
106	19-Jun-00	19-Jun-00	7:00 PM	JAG	40	8.7	0	0	0	2.155	4.037	Food Service	All Meals	Military	5	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density
107	19-Jun-00	19-Jun-00	7:00 PM	JAG	1	10.6	0	0	0	4.261	2.488	Food Service	All Meals	Military	5	7370	Volume found by taking the weight and dividing it by the calculated average material 1 density
108	19-Jun-00	19-Jun-00	7:00 PM	JAG	1	8.1	0	0	0	3.256	2.488	Food Service	All Meals	Military	5	7370	Volume found by taking the weight and dividing it by the calculated average material 1 density
109	19-Jun-00	19-Jun-00	7:00 PM	JAG	1	4.7	0	0	0	1.889	2.488	Food Service	All Meals	Military	5	7370	Volume found by taking the weight and dividing it by the calculated average material 1 density
110	19-Jun-00	19-Jun-00	7:00 PM	JAG	15	6.9	0	0	0	3.624	1.904	Food Service	All Meals	Military	6	20043	Volume found by taking the weight and dividing it by the calculated average material 15 density.
111	19-Jun-00	19-Jun-00	7:00 PM	JAG	40	11.9	0	0	0	2.948	4.037	Food Service	All Meals	Military	6	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density
112	19-Jun-00	19-Jun-00	7:00 PM	JAG	40	6.8	0	0	0	1.684	4.037	Food Service	All Meals	Military	6	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density
113	19-Jun-00	19-Jun-00	7:00 PM	JAG	40	3.7	0	0	0	0.916	4.037	Food Service	All Meals	Military	6	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density
114	19-Jun-00	19-Jun-00	7:00 PM	JAG	40	5.1	0	0	0	1.263	4.037	Food Service	All Meals	Military	6	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density
115	19-Jun-00	19-Jun-00	7:00 PM	JAG	40	7.9	0	0	0	1.957	4.037	Food Service	All Meals	Military	6	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density
116	19-Jun-00	19-Jun-00	7:00 PM	JAG	40	12.7	0	0	0	3.146	4.037	Food Service	All Meals	Military	6	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density
117	19-Jun-00	19-Jun-00	7:00 PM	JAG	40	23.6	0	0	0	5.846	4.037	Food Service	All Meals	Military	6	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density
118	19-Jun-00	19-Jun-00	7:00 PM	JAG	40	11.5	0	0	0	2.849	4.037	Food Service	All Meals	Military	6	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density
119	19-Jun-00	19-Jun-00	7:00 PM	JAG	40	10.1	0	0	0	2.502	4.037	Food Service	All Meals	Military	6	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density
120	19-Jun-00	19-Jun-00	7:00 PM	JAG	40	15.6	0	0	0	3.864	4.037	Food Service	All Meals	Military	6	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density
121	19-Jun-00	19-Jun-00	7:00 PM	JAG	40	15.8	0	0	0	3.914	4.037	Food Service	All Meals	Military	6	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density
122	19-Jun-00	19-Jun-00	7:00 PM	JAG	40	23.6	0	0	0	5.846	4.037	Food Service	All Meals	Military	6	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density
123	19-Jun-00	19-Jun-00	7:00 PM	JAG	40	6.9	0	0	0	1.709	4.037	Food Service	All Meals	Military	6	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density
124															7 TO 9		Sheets 7-9 are notes only - no data
125																	
126	20-Jun-00			Total Dumpster Vo	Total Dumpster Volume for Breakfast		22	72	82			75.167					
127	20-Jun-00	20-Jun-00	10:00 AM	WHR	40	14	0	0	0	3.468	4.037	Food Service	Breakfast	Military	10	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density
128	20-Jun-00	20-Jun-00	10:00 AM	WHR	1	10.6	0	0	0	4.261	2.488	Food Service	Breakfast	Military	10	7370	Volume found by taking the weight and dividing it by the calculated average material 1 density
129	20-Jun-00	20-Jun-00	10:00 AM	WHR	1	6.2	0	0	0	2.492	2.488	Food Service	Breakfast	Military	10	7370	Volume found by taking the weight and dividing it by the calculated average material 1 density
130	20-Jun-00	20-Jun-00	10:00 AM	WHR	40	7	0	0	0	1.734	4.037	Food Service	Breakfast	Military	10	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density
131	20-Jun-00	20-Jun-00	10:00 AM	WHR	40	14.7	0	0	0	3.641	4.037	Food Service	Breakfast	Military	10	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density

Data Key	Date Waste Produced	Date Material Analyzed	Time	Recorder	Waste Type	Weight (lb.)	Dimensions w	l	h	Volume (cu. Ft.)	Density lb/ft3	Source	Meal	Military/ Non-Military	Ref. Sheet#	Heating Value BTU/lb.	Notes
132	20-Jun-00	20-Jun-00	10:00 AM	WHR	4a	12.7	0	0	0	0.338	37.601	Food Service	Breakfast	Military	10	1000	Volume found by taking the weight and dividing it by the calculated average material 4a density
133	20-Jun-00	20-Jun-00	10:00 AM	WHR	40	12.9	0	0	0	3.195	4.037	Food Service	Breakfast	Military	10	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density
134	20-Jun-00	20-Jun-00	10:00 AM	WHR	40	10.4	0	0	0	2.576	4.037	Food Service	Breakfast	Military	10	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density
135	20-Jun-00	20-Jun-00	10:00 AM	WHR	4a	25.2	0	0	0	0.670	37.601	Food Service	Breakfast	Military	10	1000	Volume found by taking the weight and dividing it by the calculated average material 4a density
136	20-Jun-00	20-Jun-00	10:00 AM	WHR	1	8.7	0	0	0	3.497	2.488	Food Service	Breakfast	Military	10	7370	Volume found by taking the weight and dividing it by the calculated average material 1 density
137	20-Jun-00	20-Jun-00	10:00 AM	WHR	40	13.6	0	0	0	3.369	4.037	Food Service	Breakfast	Military	10	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density
138	20-Jun-00	20-Jun-00	10:00 AM	WHR	40	9.8	0	0	0	2.427	4.037	Food Service	Breakfast	Military	10	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density
139	20-Jun-00	20-Jun-00	10:00 AM	WHR	1	12.3	0	0	0	4.945	2.488	Food Service	Breakfast	Military	10	7370	Volume found by taking the weight and dividing it by the calculated average material 1 density
140	20-Jun-00	20-Jun-00	10:00 AM	WHR	4a	13.4	0	0	0	0.356	37.601	Food Service	Breakfast	Military	10	1000	Volume found by taking the weight and dividing it by the calculated average material 4a density
141	19-Jun-00	20-Jun-00	11:30 AM	WHR	7	2.2	21	20	10	2.431	0.905	Billet		Non-Military	11	13378	
142	19-Jun-00	20-Jun-00	11:30 AM	WHR	10	3	19	18	6	1.188	2.526	Billet		Military	11	7370	
143	19-Jun-00	20-Jun-00	11:30 AM	WHR	15	10.4	21	22	20	5.347	1.945	Billet		Military	11	20043	
144	19-Jun-00	20-Jun-00	11:30 AM	WHR	13	4.5	18	19	23	4.552	0.989	Billet		Military	11	9267	
145	19-Jun-00	20-Jun-00	11:30 AM	WHR	17	0.8	24	15	10	2.083	0.384	Billet		Military	11	17111	
146	19-Jun-00	20-Jun-00	11:30 AM	WHR	19	4	26	14	3	0.632	6.330	Billet		Military	11	5458	
147	19-Jun-00	20-Jun-00	11:30 AM	WHR	14	2.3	21	16	9	1.750	1.314	Billet		Military	11	9560	
148	19-Jun-00	20-Jun-00	11:30 AM	WHR	23	0.8	9	10	4	0.208	3.840	Billet		Military	11	11019	
149	19-Jun-00	20-Jun-00	11:30 AM	WHR	11	2.9	8.5	11	1	0.054	53.596	Billet		Non-Military	11	5474	
150	19-Jun-00	20-Jun-00	11:30 AM	WHR	21	1.9	19	23	6	1.517	1.252	Billet		Military	11	10275	
151	19-Jun-00	20-Jun-00	11:30 AM	WHR	1	1.179018913	13	9	7	0.474	2.488	Billet		Military	11	7370	Density recorded Is the calculated average material 1 density. The weight is calculated by multiping the the density and the volume.
152	19-Jun-00	20-Jun-00	11:30 AM	WHR	5	2	9	3	5	0.078	25.600	Billet		Non-Military	11	0	
153	19-Jun-00	20-Jun-00	11:30 AM	WHR	3	2.3	14	16	6	0.778	2.957	Billet		Military	11	7974	
154	19-Jun-00	20-Jun-00	11:30 AM	WHR	22	0.3	12	4	1	0.028	10.800	Billet		Military	11	7866	
155	19-Jun-00	20-Jun-00	11:30 AM	WHR	12	0.8	11	10	2	0.127	6.284	Billet		Military	11	8491	
156	19-Jun-00	20-Jun-00	11:30 AM	WHR	27	0.2	2	2	0.5	0.001	172.800	Billet		Non-Military	11	1403	
157	19-Jun-00	20-Jun-00	11:30 AM	WHR	4	4.9	16	13	5	0.602	8.142	Billet		Military	11	2370	
158	19-Jun-00	20-Jun-00	11:30 AM	WHR	28	5.3	16	15	6	0.833	6.360	Billet		Military	11	6040	
159	19-Jun-00	20-Jun-00	11:30 AM	WHR	25	2.7	10	10	9	0.521	5.184	Billet		Non-Military	11	13663	
160	19-Jun-00	20-Jun-00	11:30 AM	WHR	16	0.1	4	2	2	0.009	10.800	Billet		Military	11	7737	
161	19-Jun-00	20-Jun-00	11:30 AM	WHR	8	13.7	28	4	12	0.778	17.614	Billet		Non-Military	11	3185	Lower than average density (Metal tubes from folding chairs)
162	19-Jun-00	20-Jun-00	11:30 AM	WHR	20	0.05	6	0.5	0.5	0.001	57.600	Billet		Military	11	8189	
163	19-Jun-00	20-Jun-00	11:30 AM	WHR	24	0.1	3	1.5	0.5	0.001	76.800	Billet		Military	11	9910	
164	19-Jun-00	20-Jun-00	11:30 AM	WHR	10	5.7	20	17	10	1.968	2.897	Bath		Military	11	7370	
165	19-Jun-00	20-Jun-00	11:30 AM	WHR	13	0.8	17	12	4	0.472	1.694	Bath		Military	11	9267	
166	19-Jun-00	20-Jun-00	11:30 AM	WHR	17	0.3	13	12	5	0.451	0.665	Bath		Military	11	17111	
167	19-Jun-00	20-Jun-00	11:30 AM	WHR	15	2.7	22	16	9	1.833	1.473	Bath		Military	11	20043	
168	19-Jun-00	20-Jun-00	11:30 AM	WHR	7	0.6	12	12	6	0.500	1.200	Bath		Non-Military	11	13378	
169	19-Jun-00	20-Jun-00	11:30 AM	WHR	3	1.2	8	9	5	0.208	5.760	Bath		Military	11	7974	
170	19-Jun-00	20-Jun-00	12:30 PM	WHR	1	0.1	10	5	2	0.058	1.728	Bath		Military	13	7370	
171	19-Jun-00	20-Jun-00	12:30 PM	WHR	24	0.8	5	4	2	0.023	34.560	Bath		Military	13	9910	
172	19-Jun-00	20-Jun-00	12:30 PM	WHR	4	1.3	8	8	2	0.074	17.550	Bath		Military	13	2370	
173	19-Jun-00	20-Jun-00	12:30 PM	WHR	23	0.1	8	6	0.25	0.007	14.400	Bath		Military	13	11019	
174	19-Jun-00	20-Jun-00	12:30 PM	WHR	19	1.8	12	12	2	0.167	10.800	Bath		Military	13	5458	
175	19-Jun-00	20-Jun-00	12:30 PM	WHR	14	1.6	10	7	4	0.162	9.874	Bath		Military	13	9560	
176	19-Jun-00	20-Jun-00	12:30 PM	WHR	13	0.2	8	4	0.25	0.005	2.229	Bath		Military	13	9267	Density recorded Is the calculated average material 1 density.
177	19-Jun-00	20-Jun-00	12:30 PM	WHR	21	0.3	6	5	5	0.087	3.456	Bath		Non-Military	13	10275	
178	19-Jun-00	20-Jun-00	12:30 PM	JAG	4	3.5	14	12	4	0.389	9.000	Admin		Military	13	2370	
179	19-Jun-00	20-Jun-00	12:30 PM	JAG	1	1.8	10	14	14	1.134	1.587	Admin		Non-Military	13	7370	

Data Key	Date Waste Produced	Date Material Analyzed	Time	Recorder	Waste Type	Weight (lb.)	Dimensions w	l	h	Volume (cu. Ft.)	Density lb/ft3	Source	Meal	Military/ Non-Military	Ref. Sheet#	Heating Value BTU/lb.	Notes
180	19-Jun-00	20-Jun-00	12:30 PM	JAG	14	1.8	18	12	6	0.750	2.400	Admin		Non-Military	13	9560	
181	19-Jun-00	20-Jun-00	12:30 PM	JAG	22	0.2	11	3	0.25	0.005	12.655	Admin		Military	13	7866	Density recorded is the calculated average material 22 density.
182	19-Jun-00	20-Jun-00	12:30 PM	JAG	19	1.1	7	5	2	0.041	12.625	Admin		Military	13	5458	Density recorded is the calculated average material 19 density.
183	19-Jun-00	20-Jun-00	12:30 PM	JAG	23	0.3	7	5	0.5	0.010	9.943	Admin		Military	13	11019	The density recorded is the calculated average material 23 density.
184	19-Jun-00	20-Jun-00	12:30 PM	JAG	21	0.3	12	12	2	0.167	1.800	Admin		Military	13	10275	
185	19-Jun-00	20-Jun-00	12:30 PM	JAG	17	0.5	13	12	5	0.451	1.108	Admin		Military	13	17111	
186	19-Jun-00	20-Jun-00	12:30 PM	JAG	5	0.8	3	3	7	0.036	21.943	Admin		Military	13	0	
187	19-Jun-00	20-Jun-00	12:30 PM	JAG	10	4.5	18	12	8	1.000	4.500	Admin		Non-Military	13	7370	
188	19-Jun-00	20-Jun-00	12:30 PM	JAG	15	1.8	21	18	9	1.969	0.914	Admin		Military	13	20043	
189	19-Jun-00	20-Jun-00	12:30 PM	JAG	13	1.2	18	13	5	0.677	1.772	Admin		Non-Military	13	9267	
190	19-Jun-00	20-Jun-00	12:30 PM	JAG	7	1.2	22	14	5	0.891	1.346	Admin		Non-Military	13	13378	
191	20-Jun-00	20-Jun-00	2:00 PM	JAG	1	9.1	0	0	0	3.658	2.488	Food Service	Lunch	Military	12	7370	Time recored is an estimated starting time. Volume found by taking the weight and dividing it by the calculated average material 1 density
192	20-Jun-00	20-Jun-00	2:00 PM	JAG	1	9.2	0	0	0	3.698	2.488	Food Service	Lunch	Military	12	7370	No Volume Recorded. Volume found by taking the weight and dividing it by the calculated average material 1 density
193	20-Jun-00	20-Jun-00	2:00 PM	JAG	4a	16.8	0	0	0	0.447	37.601	Food Service	Lunch	Military	12	1000	Volume found by taking the weight and dividing it by the calculated average material 4a density
194	20-Jun-00	20-Jun-00	2:00 PM	JAG	21	10	0	0	0	3.194	3.130	Food Service	Lunch	Military	12	10275	Volume found by taking the weight and dividing it by the calculated average material 21 density
195	20-Jun-00	20-Jun-00	2:00 PM	JAG	21	20	0	0	0	6.389	3.130	Food Service	Lunch	Military	12	10275	Volume found by taking the weight and dividing it by the calculated average material 21 density
196	20-Jun-00	20-Jun-00	2:00 PM	JAG	40	16.6	0	0	0	4.112	4.037	Food Service	Lunch	Military	12	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density
197	20-Jun-00	20-Jun-00	2:00 PM	JAG	40	14	0	0	0	3.468	4.037	Food Service	Lunch	Military	12	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density
198	20-Jun-00	20-Jun-00	7:45 PM	WHR	1	6.3	0	0	0	2.533	2.488	Food Service	Dinner	Military	15	7370	Volume found by taking the weight and dividing it by the calculated average material 1 density
199	20-Jun-00	20-Jun-00	7:45 PM	WHR	40	5.8	0	0	0	1.437	4.037	Food Service	Dinner	Military	15	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density.
200	20-Jun-00	20-Jun-00	7:45 PM	WHR	40	4.9	0	0	0	1.214	4.037	Food Service	Dinner	Military	15	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density.
201	20-Jun-00	20-Jun-00	7:45 PM	WHR	40	17.6	0	0	0	4.359	4.037	Food Service	Dinner	Military	15	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density.
202	20-Jun-00	20-Jun-00	7:45 PM	WHR	40	27.1	0	0	0	6.713	4.037	Food Service	Dinner	Military	15	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density.
203	20-Jun-00	20-Jun-00	7:45 PM	WHR	40	19	0	0	0	4.706	4.037	Food Service	Dinner	Military	15	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density.
204	20-Jun-00	20-Jun-00	7:45 PM	WHR	4a	16.2	0	0	0	0.431	37.601	Food Service	Dinner	Military	15	1000	Volume found by taking the weight and dividing it by the calculated average material 4a density
205	20-Jun-00	20-Jun-00	7:45 PM	WHR	4a	18.7	0	0	0	0.497	37.601	Food Service	Dinner	Military	15	1000	Volume found by taking the weight and dividing it by the calculated average material 4a density
206	20-Jun-00	20-Jun-00	7:45 PM	WHR	40	12.4	0	0	0	3.071	4.037	Food Service	Dinner	Military	15	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density.
207	20-Jun-00	20-Jun-00	7:45 PM	WHR	40	7.6	0	0	0	1.883	4.037	Food Service	Dinner	Military	15	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density.
208	20-Jun-00	20-Jun-00	7:45 PM	WHR	40	17.2	0	0	0	4.260	4.037	Food Service	Dinner	Military	15	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density.
209	20-Jun-00	20-Jun-00	7:45 PM	WHR	40	11.4	0	0	0	2.824	4.037	Food Service	Dinner	Military	15	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density.
210	20-Jun-00	20-Jun-00	7:45 PM	WHR	40	10.2	0	0	0	2.527	4.037	Food Service	Dinner	Military	15	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density.
211	20-Jun-00	20-Jun-00	7:45 PM	WHR	40	13.8	0	0	0	3.418	4.037	Food Service	Dinner	Military	15	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density.
212	20-Jun-00	20-Jun-00	7:45 PM	WHR	1	4.6	0	0	0	1.849	2.488	Food Service	Dinner	Military	15	7370	Volume found by taking the weight and dividing it by the calculated average material 1 density

Data Key	Date Waste Produced	Date Material Analyzed	Time	Recorder	Waste Type	Weight (lb.)	Dimensions w	l	h	Volume (cu. Ft.)	Density lb/ft3	Source	Meal	Military/ Non-Military	Ref. Sheet#	Heating Value BTU/lb.	Notes
213	20-Jun-00	20-Jun-00	7:45 PM	WHR	1	1.5	0	0	0	0.603	2.488	Food Service	Dinner	Military	15	7370	Volume found by taking the weight and dividing it by the calculated average material 1 density
214	20-Jun-00	20-Jun-00	7:45 PM	WHR	1	1.5	0	0	0	0.603	2.488	Food Service	Dinner	Military	15	7370	Volume found by taking the weight and dividing it by the calculated average material 1 density
215																	
216	21-Jun-00			Total DumpsterVol	Total Dumpster Volume Breakfast		21	72	82			Food Service	71.750				
217	21-Jun-00	21-Jun-00	10:00 AM	MAH	1	8.6	0	0	0	3.457	2.488	Food Service	Breakfast	Military	17	7370	Volume found by taking the weight and dividing it by the calculated average material 1 density
218	21-Jun-00	21-Jun-00	10:00 AM	MAH	1	4.2	0	0	0	1.688	2.488	Food Service	Breakfast	Military	17	7370	Volume found by taking the weight and dividing it by the calculated average material 1 density
219	21-Jun-00	21-Jun-00	10:00 AM	MAH	1	4.6	0	0	0	1.849	2.488	Food Service	Breakfast	Military	17	7370	Volume found by taking the weight and dividing it by the calculated average material 1 density
220	21-Jun-00	21-Jun-00	10:00 AM	MAH	1	1.8	0	0	0	0.724	2.488	Food Service	Breakfast	Military	17	7370	Volume found by taking the weight and dividing it by the calculated average material 1 density
221	21-Jun-00	21-Jun-00	10:00 AM	MAH	1	6.7	0	0	0	2.693	2.488	Food Service	Breakfast	Military	17	7370	Volume found by taking the weight and dividing it by the calculated average material 1 density
222	21-Jun-00	21-Jun-00	10:00 AM	MAH	40	16.1	0	0	0	3.988	4.037	Food Service	Breakfast	Military	17	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density.
223	21-Jun-00	21-Jun-00	10:00 AM	MAH	40	16.2	0	0	0	4.013	4.037	Food Service	Breakfast	Military	17	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density.
224	21-Jun-00	21-Jun-00	10:00 AM	MAH	1	3.3	0	0	0	1.327	2.488	Food Service	Breakfast	Military	17	7370	Volume found by taking the weight and dividing it by the calculated average material 1 density
225	21-Jun-00	21-Jun-00	10:00 AM	MAH	4a	12.7	0	0	0	0.338	37.601	Food Service	Breakfast	Military	17	1000	Volume found by taking the weight and dividing it by the calculated average material 4a density
226	21-Jun-00	21-Jun-00	10:00 AM	MAH	1	1.7	0	0	0	0.683	2.488	Food Service	Breakfast	Military	17	7370	Volume found by taking the weight and dividing it by the calculated average material 1 density
227	21-Jun-00	21-Jun-00	10:00 AM	MAH	40	7.7	0	0	0	1.907	4.037	Food Service	Breakfast	Military	17	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density.
228	21-Jun-00	21-Jun-00	10:00 AM	MAH	40	6.9	0	0	0	1.709	4.037	Food Service	Breakfast	Military	17	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density.
229	21-Jun-00	21-Jun-00	10:00 AM	MAH	40	26.9	0	0	0	6.663	4.037	Food Service	Breakfast	Military	17	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density.
230	21-Jun-00	21-Jun-00	10:00 AM	MAH	4a	10	0	0	0	0.266	37.601	Food Service	Breakfast	Military	17	1000	Volume found by taking the weight and dividing it by the calculated average material 4a density
231	20-Jun-00	21-Jun-00	11:05 AM	WHR	7	3.6	23	23	10	3.061	1.176	Billet		Non-Military	18	13378	
232	20-Jun-00	21-Jun-00	11:05 AM	WHR	13	5.5	23	15	12	2.396	2.296	Billet		Military	18	9267	
233	20-Jun-00	21-Jun-00	11:05 AM	WHR	15	7.1	26	22	11	3.641	1.950	Billet		Military	18	20043	
234	20-Jun-00	21-Jun-00	11:05 AM	WHR	15	7.6	12	18	19	2.375	3.200	Billet		Military	18	20043	
235	20-Jun-00	21-Jun-00	11:05 AM	WHR	15	3.7	20	15	14	2.431	1.522	Billet		Military	18	20043	
236	20-Jun-00	21-Jun-00	11:05 AM	WHR	10	5.4	19	18	9	1.781	3.032	Billet		Military	18	7370	
237	20-Jun-00	21-Jun-00	11:05 AM	WHR	17	0.6	15	16	4	0.556	1.080	Billet		Military	18	17111	
238	20-Jun-00	21-Jun-00	11:05 AM	WHR	22	0.3	12	4	3	0.083	3.600	Billet		Military	18	7866	
239	20-Jun-00	21-Jun-00	11:05 AM	WHR	3	3.5	12	12	6	0.500	7.000	Billet		Military	18	7974	
240	20-Jun-00	21-Jun-00	11:05 AM	WHR	28	1.6	10	11	3	0.191	8.378	Billet		Military	18	6040	
241	20-Jun-00	21-Jun-00	11:05 AM	WHR	4	14.5	16	14	8	1.037	13.982	Billet		Military	18	2370	
242	20-Jun-00	21-Jun-00	11:05 AM	WHR	1	4.6	12	12	16	1.333	3.450	Billet		Military	18	7370	
243	20-Jun-00	21-Jun-00	11:05 AM	WHR	1	6.3	16	11	18	1.833	3.436	Billet		Military	18	7370	
244	20-Jun-00	21-Jun-00	11:05 AM	WHR	1	5.7	11	16	20	2.037	2.798	Billet		Military	18	7370	
245	20-Jun-00	21-Jun-00	11:05 AM	WHR	21	3	17	18	5	0.885	3.388	Billet		Military	18	10275	
246	20-Jun-00	21-Jun-00	11:05 AM	WHR	14	7.3	20	18	17	3.542	2.061	Billet		Military	18	9560	
247	20-Jun-00	21-Jun-00	11:05 AM	WHR	5	3.1	6	6	9	0.188	16.533	Billet		Non-Military	18	0	
248	20-Jun-00	21-Jun-00	11:05 AM	WHR	23	1.8	12	12	4	0.333	5.400	Billet		Military	18	11019	
249	20-Jun-00	21-Jun-00	11:05 AM	WHR	27	0.5	6	2	0.5	0.003	144.000	Billet		Non-Military	18	1403	
250	20-Jun-00	21-Jun-00	11:05 AM	WHR	19	13.7	16	15	6	0.833	16.440	Billet		Military	18	5458	
251	20-Jun-00	21-Jun-00	11:05 AM	WHR	12	0.4	12	12	1	0.083	4.800	Billet		Military	18	8491	
252	20-Jun-00	21-Jun-00	11:05 AM	WHR	11	1.2	8.5	11	0.5	0.027	44.355	Billet		Non-Military	18	5474	
253	20-Jun-00	21-Jun-00	11:05 AM	WHR	20	0.3	17	2	0.5	0.010	30.494	Billet		Military	18	8189	
254	20-Jun-00	21-Jun-00	11:05 AM	WHR	8	1.1	10	4	0.5	0.012	95.040	Billet		Military	18	3185	

Data Key	Date Waste Produced	Date Material Analyzed	Time	Recorder	Waste Type	Weight (lb.)	Dimensions w	l	h	Volume (cu. Ft.)	Density lb/ft3	Source	Meal	Military/ Non-Military	Ref. Sheet#	Heating Value BTU/lb.	Notes
255	20-Jun-00	21-Jun-00	11:05 AM	WHR	27	0.05	2	0.5	0.5	0.000	172.800	Billet		Non-Military	18	1403	
256	20-Jun-00	21-Jun-00	11:05 AM	WHR	25	0.1	0	0	0	0.019	5.184	Billet		Military	18	13663	Voume found by taking the weight and dividing it by the only found material 25 density
257	20-Jun-00	21-Jun-00	11:05 AM	WHR	43	3.2	0	0	0	0.134	23.938	Billet			18	#REF!	Volume = 1gallon of paint(almost full 1 gallon can)
258	20-Jun-00	21-Jun-00	11:55 AM	WHR	10	3.7	18	16	9	1.500	2.467	Food Service		Military	20	7370	This waste came from hand washing station
259	20-Jun-00	21-Jun-00	11:55 AM	WHR	17	0.05	3	6	3	0.031	1.600	Food Service		Military	20	17111	This waste came from hand washing station
260	20-Jun-00	21-Jun-00	11:55 AM	WHR	13	0.1	0	0	0	0.045	2.229	Food Service		Military	20	9267	Volume found by taking the weight and dividing it by the calculated average material 13 density. This waste came from hand washing station
261	20-Jun-00	21-Jun-00	11:55 AM	WHR	7	0.1	6	4	5	0.069	1.440	Food Service		Military	20	13378	This waste came from hand washing station
262	20-Jun-00	21-Jun-00	11:55 AM	WHR	15	0.1	0	0	0	0.053	1.904	Food Service		Military	20	20043	Volume found by taking the weight and dividing it by the calculated average material 15 density.This waste came from hand washing station.
263	20-Jun-00	21-Jun-00	11:55 AM	WHR	14	0.1	6	5	0.5	0.009	11.520	Food Service		Military	20	9560	This waste came from hand washing station
264	20-Jun-00	21-Jun-00	11:55 AM	WHR	4a	0.2	7	2	0.5	0.004	49.371	Food Service		Military	20	1000	This waste came from hand washing station.
265	20-Jun-00	21-Jun-00	11:55 AM	WHR	7	0.2	5	3	4	0.035	5.760	Bath		Non-Military	20	13378	
266	20-Jun-00	21-Jun-00	11:55 AM	WHR	17	0.5	17	12	12	1.417	0.353	Bath		Non-Military	20	17111	
267	20-Jun-00	21-Jun-00	11:55 AM	WHR	15	1.9	18	17	5	0.885	2.146	Bath		Non-Military	20	20043	
268	20-Jun-00	21-Jun-00	11:55 AM	WHR	10	6.4	15	20	15	2.604	2.458	Bath		Military	20	7370	
269	20-Jun-00	21-Jun-00	11:55 AM	WHR	16	0.05	0	0	0	0.005	10.800	Bath		Military	20	7737	Volume found by taking the weight and dividing it by the only found material 16 density.
270	20-Jun-00	21-Jun-00	11:55 AM	WHR	1	0.524008406	28	26	0.5	0.211	2.488	Bath		Military	20	7370	Density recorded Is the calculated average material 1 density. The weight is calculated by multiping the the density and the volume.
271	20-Jun-00	21-Jun-00	11:55 AM	WHR	13	0.4	12	12	4	0.333	1.200	Bath		Military	20	9267	
272	20-Jun-00	21-Jun-00	11:55 AM	WHR	24	0.1	2	3	0.5	0.002	57.600	Bath		Military	20	9910	
273	20-Jun-00	21-Jun-00	11:55 AM	WHR	3	0.6	6	6	3	0.063	9.600	Bath		Military	20	7974	
274	20-Jun-00	21-Jun-00	11:55 AM	WHR	22	0.3	6	3	3	0.031	9.600	Bath		Military	20	7866	
275	20-Jun-00	21-Jun-00	11:55 AM	WHR	14	0.8	10	8	7	0.324	2.469	Bath		Military	20	9560	
276	20-Jun-00	21-Jun-00	11:55 AM	WHR	21	0.3	8	4	4	0.074	4.050	Bath		Non-Military	20	10275	
277	20-Jun-00	21-Jun-00	11:55 AM	WHR	4	0.1	6	2	0.5	0.003	28.800	Bath		Military	20	2370	
278	20-Jun-00	21-Jun-00	11:55 AM	WHR	1	0.3	8	5	3	0.069	4.320	Admin		Military	20	7370	
279	20-Jun-00	21-Jun-00	11:55 AM	WHR	10	5	18	15	13	2.031	2.462	Admin		Military	20	7370	
280	20-Jun-00	21-Jun-00	11:55 AM	WHR	19	0.4	5	5	2	0.029	13.824	Admin		Military	20	5458	
281	20-Jun-00	21-Jun-00	11:55 AM	WHR	23	0.3	8	5	1	0.023	12.960	Admin		Military	20	11019	
282	20-Jun-00	21-Jun-00	11:55 AM	WHR	14	0.3	12	7	4	0.194	1.543	Admin		Military	20	9560	
283	20-Jun-00	21-Jun-00	11:55 AM	WHR	21	0.4	12	12	2	0.167	2.400	Admin		Military	20	10275	
284	20-Jun-00	21-Jun-00	11:55 AM	WHR	12	0.4	12	7	1	0.049	8.229	Admin		Military	20	8491	
285	20-Jun-00	21-Jun-00	12:45 PM	WHR	7	0.1	9	5	3	0.078	1.280	Admin		Military	21	13378	
286	20-Jun-00	21-Jun-00	12:45 PM	WHR	17	0.1	10	3	3	0.052	1.920	Admin		Military	21	17111	
287	20-Jun-00	21-Jun-00	12:45 PM	WHR	13	0.3	12	9	2	0.125	2.400	Admin		Military	21	9267	
288	20-Jun-00	21-Jun-00	12:45 PM	WHR	15	0.9	12	12	4	0.333	2.700	Admin		Military	21	20043	
289	20-Jun-00	21-Jun-00	12:45 PM	WHR	4	1.2	9	7	3	0.109	10.971	Admin		Military	21	2370	
290	20-Jun-00	21-Jun-00	12:45 PM	WHR	10	3.5	20	20	13	3.009	1.163	Billet		Military	21	7370	Packaging waste found next to bathroom
291	20-Jun-00	21-Jun-00	12:45 PM	WHR	17	1	18	10	13	1.354	0.738	Billet		Military	21	17111	Packaging waste found next to bathroom
292	21-Jun-00	21-Jun-00	2:00 PM	MAH	40	41.1	24	25	24	8.333	4.932	Food Service	Lunch	Military	19	6710	Time recorded is an estimated starting time.
293	21-Jun-00	21-Jun-00	2:00 PM	MAH	1	4.1	16	22	15	3.056	1.342	Food Service	Lunch	Military	19	7370	
294	21-Jun-00	21-Jun-00	2:00 PM	MAH	40	22	23	20	18	4.792	4.591	Food Service	Lunch	Military	19	6710	
292	21-Jun-00				Total Dumpster Volume Dinner		26	72	82			Food Service	88.833				
293	21-Jun-00	21-Jun-00	8:45 PM	MAH	40	11.4	0	0	0	2.824	4.037	Food Service	Dinner	Military	22	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density.
294	21-Jun-00	21-Jun-00	8:45 PM	MAH	40	11.4	0	0	0	2.824	4.037	Food Service	Dinner	Military	22	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density.
295	21-Jun-00	21-Jun-00	8:45 PM	MAH	1	6.8	0	0	0	2.734	2.488	Admin	Dinner	Military	22	7370	Volume found by taking the weight and dividing it by the calculated average material 1 density

Data Key	Date Waste Produced	Date Material Analyzed	Time	Recorder	Waste Type	Weight (lb.)	Dimensions w	l	h	Volume (cu. Ft.)	Density lb/ft3	Source	Meal	Military/ Non-Military	Ref. Sheet#	Heating Value BTU/lb.	Notes
296	21-Jun-00	21-Jun-00	8:45 PM	MAH	40	5.2	0	0	0	1.288	4.037	Food Service	Dinner	Military	22	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density.
297	21-Jun-00	21-Jun-00	8:45 PM	MAH	40	1.3	0	0	0	0.322	4.037	Food Service	Dinner	Military	22	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density.
298	21-Jun-00	21-Jun-00	8:45 PM	MAH	40	7.8	0	0	0	1.932	4.037	Food Service	Dinner	Military	22	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density.
299	21-Jun-00	21-Jun-00	8:45 PM	MAH	40	12.8	0	0	0	3.171	4.037	Food Service	Dinner	Military	22	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density.
300	21-Jun-00	21-Jun-00	8:45 PM	MAH	40	10.6	0	0	0	2.626	4.037	Food Service	Dinner	Military	22	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density.
301	21-Jun-00	21-Jun-00	8:45 PM	MAH	40	16.3	0	0	0	4.037	4.037	Food Service	Dinner	Military	22	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density.
302	21-Jun-00	21-Jun-00	8:45 PM	MAH	40	17	0	0	0	4.211	4.037	Food Service	Dinner	Military	22	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density.
303	21-Jun-00	21-Jun-00	8:45 PM	MAH	40	12.7	0	0	0	3.146	4.037	Food Service	Dinner	Military	22	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density.
304	21-Jun-00	21-Jun-00	8:45 PM	MAH	1	21.6	0	0	0	8.683	2.488	Food Service	Dinner	Military	22	7370	Volume found by taking the weight and dividing it by the calculated average material 1 density
305	21-Jun-00	21-Jun-00	8:45 PM	MAH	4a	16.9	0	0	0	0.449	37.601	Food Service	Dinner	Military	22	1000	Volume found by taking the weight and dividing it by the calculated average material 4a density
306	21-Jun-00	21-Jun-00	8:45 PM	MAH	40	16.3	0	0	0	4.037	4.037	Food Service	Dinner	Military	22	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density.
307	21-Jun-00	21-Jun-00	8:45 PM	MAH	1	0.7	0	0	0	0.281	2.488	Food Service	Dinner	Military	22	7370	Volume found by taking the weight and dividing it by the calculated average material 1 density
308	21-Jun-00	21-Jun-00	8:45 PM	MAH	40	19.5	0	0	0	4.830	4.037	Food Service	Dinner	Military	22	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density.
309	21-Jun-00	21-Jun-00	8:45 PM	MAH	40	16.4	0	0	0	4.062	4.037	Food Service	Dinner	Military	22	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density.
310	21-Jun-00	21-Jun-00	8:45 PM	MAH	40	12.5	0	0	0	3.096	4.037	Food Service	Dinner	Military	22	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density.
311	21-Jun-00	21-Jun-00	8:45 PM	MAH	1	0.7	0	0	0	0.281	2.488	Food Service	Dinner	Military	22	7370	Volume found by taking the weight and dividing it by the calculated average material 1 density
312																	
313																	
314	21-Jun-00	22-Jun-00	9:45 AM	WHR	13	2.7	18	15	8	1.250	2.160	Billet		Military	24	9267	
315	21-Jun-00	22-Jun-00	9:45 AM	WHR	17	1.2	19	17	7	1.308	0.917	Billet		Military	24	17111	
316	21-Jun-00	22-Jun-00	9:45 AM	WHR	7	3.1	20	16	8	1.481	2.093	Billet		Non-Military	24	13378	
317	21-Jun-00	22-Jun-00	9:45 AM	WHR	27	0.5	5	2	0.5	0.003	172.800	Billet		Non-Military	24	1403	
318	21-Jun-00	22-Jun-00	9:45 AM	WHR	15	11.6	18	16	23	3.833	3.026	Billet		Military	24	20043	
319	21-Jun-00	22-Jun-00	9:45 AM	WHR	10	5.9	12	17	10	1.181	4.998	Billet		Military	24	7370	
320	21-Jun-00	22-Jun-00	9:45 AM	WHR	4	1.8	9	10	3	0.156	11.520	Billet		Military	24	2370	
321	21-Jun-00	22-Jun-00	9:45 AM	WHR	1	8.4	18	10	22	2.292	3.665	Billet		Military	24	7370	
322	21-Jun-00	22-Jun-00	9:45 AM	WHR	4	7.2	16	10	8	0.741	9.720	Billet		Military	24	2370	
323	21-Jun-00	22-Jun-00	9:45 AM	WHR	28	1.3	12	8	5	0.278	4.680	Billet		Military	24	6040	
324	21-Jun-00	22-Jun-00	9:45 AM	WHR	23	1.4	12	10	3	0.208	6.720	Billet		Military	24	11019	
325	21-Jun-00	22-Jun-00	9:45 AM	WHR	24	0.1	2	4	0.5	0.002	43.200	Billet		Military	24	9910	
326	21-Jun-00	22-Jun-00	9:45 AM	WHR	5	1.3	4	5	3	0.035	37.440	Billet		Military	24	0	
327	21-Jun-00	22-Jun-00	9:45 AM	WHR	26	0.1	1	1	1	0.001	172.800	Billet		Military	24	0	
328	21-Jun-00	22-Jun-00	9:45 AM	WHR	14	13.4	14	18	9	1.313	10.210	Billet		Military	24	9560	
329	21-Jun-00	22-Jun-00	9:45 AM	WHR	8	0.3	5	4	0.25	0.003	103.680	Billet		Military	24	3185	
330	21-Jun-00	22-Jun-00	9:45 AM	WHR	21	2.4	16	16	7	1.037	2.314	Billet		Military	24	10275	
331	21-Jun-00	22-Jun-00	9:45 AM	WHR	12	1.3	12	12	3	0.250	5.200	Billet		Military	24	8491	
332	21-Jun-00	22-Jun-00	9:45 AM	WHR	20	0.1	5	2	0.5	0.003	34.560	Billet		Military	24	8189	
333	21-Jun-00	22-Jun-00	9:45 AM	WHR	14	2.8	16	18	8	1.333	2.100	Billet		Military	24	9560	
334	21-Jun-00	22-Jun-00	9:45 AM	WHR	10	5.8	17	10	15	1.476	3.930	Bath		Military	24	7370	
335	21-Jun-00	22-Jun-00	9:45 AM	WHR	10	2.4	15	14	10	1.215	1.975	Bath		Military	24	7370	
336	21-Jun-00	22-Jun-00	9:45 AM	WHR	17	0.1	7	6	6	0.146	0.686	Bath		Military	24	17111	
337	21-Jun-00	22-Jun-00	9:45 AM	WHR	15	1	15	15	5	0.651	1.536	Bath		Military	24	20043	
338	21-Jun-00	22-Jun-00	9:45 AM	WHR	7	0.4	5	5	5	0.072	5.530	Bath		Non-Military	24	13378	
339	21-Jun-00	22-Jun-00	9:45 AM	WHR	13	0.1	3	3	8	0.042	2.400	Bath		Non-Military	24	9267	
340	21-Jun-00	22-Jun-00	9:45 AM	WHR	24	0.3	2	3	2	0.007	43.200	Bath		Military	24	9910	

Data Key	Date Waste Produced	Date Material Analyzed	Time	Recorder	Waste Type	Weight (lb.)	Dimensions w	l	h	Volume (cu. Ft.)	Density lb/ft3	Source	Meal	Military/ Non-Military	Ref. Sheet#	Heating Value BTU/lb.	Notes
341	21-Jun-00	22-Jun-00	9:45 AM	WHR	3	1.3	10	8	4	0.185	7.020	Bath		Military	24	7974	
342	21-Jun-00	22-Jun-00	9:45 AM	WHR	14	1.6	12	11	5	0.382	4.189	Bath		Military	24	9560	
343	21-Jun-00	22-Jun-00	10:30 AM	WHR	10	2.8	16	18	7	1.167	2.400	Food Service		Military	25	7370	
344	21-Jun-00	22-Jun-00	10:30 AM	WHR	1	2.3	18	16	9	1.500	1.533	Billet		Military	25	7370	Packaging material found outside latrines
345	21-Jun-00	22-Jun-00	10:30 AM	WHR	17	2.4	14	18	19	2.771	0.866	Billet		Military	25	17111	Packaging material found outside latrines
346	21-Jun-00	22-Jun-00	10:30 AM	WHR	10	3.9	12	16	16	1.778	2.194	Billet		Military	25	7370	Packaging material found outside latrines
347	21-Jun-00	22-Jun-00	10:30 AM	WHR	15	0.9	18	12	9	1.125	0.800	Billet		Military	25	20043	Packaging material found outside latrines
348	21-Jun-00	22-Jun-00	10:30 AM	WHR	7	0.1	5	6	3	0.052	1.920	Billet		Military	25	13378	Packaging material found outside latrines
349	21-Jun-00	22-Jun-00	10:30 AM	WHR	13	0.1	6	4	1	0.014	7.200	Billet		Military	25	9267	Packaging material found outside latrines
350	21-Jun-00	22-Jun-00	10:30 AM	WHR	13	1.7	16	17	9	1.417	1.200	Admin		Non-Military	25	9267	
351	21-Jun-00	22-Jun-00	10:30 AM	WHR	7	1.4	18	16	6	1.000	1.400	Admin		Non-Military	25	13378	
352	21-Jun-00	22-Jun-00	10:30 AM	WHR	15	0.8	16	12	6	0.667	1.200	Admin		Military	25	20043	
353	21-Jun-00	22-Jun-00	10:30 AM	WHR	17	0.7	13	15	7	0.790	0.886	Admin		Military	25	17111	
354	21-Jun-00	22-Jun-00	10:30 AM	WHR	10	0.6	12	16	3	0.333	1.800	Admin		Military	25	7370	
355	21-Jun-00	22-Jun-00	10:30 AM	WHR	14	0.8	11	15	6	0.573	1.396	Admin		Non-Military	25	9560	
356	21-Jun-00	22-Jun-00	10:30 AM	WHR	4	2.5	16	10	3	0.278	9.000	Admin		Military	25	2370	
357	21-Jun-00	22-Jun-00	10:30 AM	WHR	3	0.1	9	6	0.5	0.016	6.400	Admin		Military	25	7974	
358	21-Jun-00	22-Jun-00	10:30 AM	WHR	21	0.2	14	5	5	0.203	0.987	Admin		Non-Military	25	10275	
359	21-Jun-00	22-Jun-00	10:30 AM	WHR	29	0.1	6	5	1	0.017	5.760	Admin		Military	25	16055	
360	21-Jun-00	22-Jun-00	10:30 AM	WHR	1	0.1	10	14	0.25	0.020	4.937	Admin		Military	25	7370	
361																	
362	22-Jun-00			Total Dumpster Vo	Total Dumpster Volume Breakfast		20	72	82			68.333					
363	22-Jun-00	22-Jun-00	11:00 AM	JAG	1	9.5	0	0	0	3.819	2.488	Food Service	Breakfast	Military	26	7370	Time recorded is an estimated starting time. Volume found by taking the weight and dividing it by the calculated average material 1 density
364	22-Jun-00	22-Jun-00	11:00 AM	JAG	1	9.8	0	0	0	3.940	2.488	Food Service	Breakfast	Military	26	7370	Volume found by taking the weight and dividing it by the calculated average material 1 density
365	22-Jun-00	22-Jun-00	11:00 AM	JAG	8	0.8	0	0	0	0.008	104.640	Food Service	Breakfast	Military	26	3185	Volume found by taking the weight and dividing it by the calcualted average material 8 density
366	22-Jun-00	22-Jun-00	11:00 AM	JAG	40	15	0	0	0	3.715	4.037	Food Service	Breakfast	Military	26	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density.
367	22-Jun-00	22-Jun-00	11:00 AM	JAG	40	17	0	0	0	4.211	4.037	Food Service	Breakfast	Military	26	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density.
368	22-Jun-00	22-Jun-00	11:00 AM	JAG	4a	6.4	0	0	0	0.170	37.601	Food Service	Breakfast	Military	26	1000	Volume found by taking the weight and dividing it by the calculated average material 4a density
369	22-Jun-00	22-Jun-00	11:00 AM	JAG	1	3.5	0	0	0	1.407	2.488	Food Service	Breakfast	Military	26	7370	Volume found by taking the weight and dividing it by the calculated average material 1 density
370	22-Jun-00	22-Jun-00	11:00 AM	JAG	1	9.2	0	0	0	3.698	2.488	Food Service	Breakfast	Military	26	7370	Volume found by taking the weight and dividing it by the calculated average material 1 density
371	22-Jun-00	22-Jun-00	11:00 AM	JAG	40	17.8	0	0	0	4.409	4.037	Food Service	Breakfast	Military	26	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density.
372	22-Jun-00	22-Jun-00	11:00 AM	JAG	40	12.4	0	0	0	3.071	4.037	Food Service	Breakfast	Military	26	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density.
373	22-Jun-00	22-Jun-00	11:00 AM	JAG	40	2.5	0	0	0	0.619	4.037	Food Service	Breakfast	Military	26	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density.
374	22-Jun-00	22-Jun-00	11:00 AM	JAG	1	2.5	0	0	0	1.005	2.488	Billet	Breakfast	Military	26	7370	Volume found by taking the weight and dividing it by the calculated average material 1 density
375	22-Jun-00	22-Jun-00	11:00 AM	JAG	40	20.1	0	0	0	4.979	4.037	Food Service	Breakfast	Military	26	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density.
376	22-Jun-00	22-Jun-00	2:00 PM	JAG	4a	159.25	10	21	21	2.552	62.400	Food Service	Lunch	Military	27	1000	Weight is calculated based on 62.4 lb/cu ft due to weight above scale's range
377	22-Jun-00	22-Jun-00	2:00 PM	JAG	40	45.8	0	0	0	11.345	4.037	Food Service	Lunch	Military	27	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density.
378	22-Jun-00	22-Jun-00	2:00 PM	JAG	40	20.7	0	0	0	5.127	4.037	Food Service	Lunch	Military	27	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density.
379	22-Jun-00	22-Jun-00	2:00 PM	JAG	1	13.6	48	17	10	4.722	2.880	Food Service	Lunch	Military	27	7370	
380	22-Jun-00	22-Jun-00	2:00 PM	JAG	19	15.1	0	0	0	1.196	12.625	Food Service	Lunch	Military	27	5458	Volume found by taking the weight and dividing it by the calculated average material 19 density.

Data Key	Date Waste Produced	Date Material Analyzed	Time	Recorder	Waste Type	Weight (lb.)	Dimensions w	l	h	Volume (cu. Ft.)	Density lb/ft3	Source	Meal	Military/ Non-Military	Ref. Sheet#	Heating Value BTU/lb.	Notes
381	22-Jun-00	22-Jun-00	2:00 PM	JAG	23	4.6	0	0	0	0.463	9.943	Food Service	Lunch	Military	27	11019	Volume found by taking the weight and dividing it by the calculated average material 23 density.
382	22-Jun-00	22-Jun-00	2:00 PM	JAG	40	6.3	0	0	0	1.560	4.037	Food Service	Lunch	Military	27	6710	Breakfast waste found in dumpster with waste trash. Volume found by taking the weight and dividing it by the calculated average material 40 density.
383	22-Jun-00	22-Jun-00	2:00 PM	JAG	40	4.1	0	0	0	1.016	4.037	Food Service	Lunch	Military	27	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density.
384	22-Jun-00	22-Jun-00	8:40 PM	JAG	40	8.6	0	0	0	2.130	4.037	Food Service	Dinner	Military	28	6710	No Dumpster Volume taken for this meal. Volume found by taking the weight and dividing it by the calculated average material 40 density.
385	22-Jun-00	22-Jun-00	8:40 PM	JAG	4a	15.8	0	0	0	0.420	37.601	Food Service	Dinner	Military	28	1000	Volume found by taking the weight and dividing it by the calculated average material 4a density
386	22-Jun-00	22-Jun-00	8:40 PM	JAG	40	12.2	0	0	0	3.022	4.037	Food Service	Dinner	Military	28	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density.
387	22-Jun-00	22-Jun-00	8:40 PM	JAG	40	7.4	0	0	0	1.833	4.037	Food Service	Dinner	Military	28	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density.
388	22-Jun-00	22-Jun-00	8:40 PM	JAG	40	13.3	0	0	0	3.294	4.037	Food Service	Dinner	Military	28	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density.
389	22-Jun-00	22-Jun-00	8:40 PM	JAG	40	16.4	0	0	0	4.062	4.037	Food Service	Dinner	Military	28	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density.
390	22-Jun-00	22-Jun-00	8:40 PM	JAG	40	15.8	0	0	0	3.914	4.037	Food Service	Dinner	Military	28	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density.
391	22-Jun-00	22-Jun-00	8:40 PM	JAG	40	5.9	0	0	0	1.461	4.037	Food Service	Dinner	Military	28	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density.
392	22-Jun-00	22-Jun-00	8:40 PM	JAG	40	11.6	0	0	0	2.873	4.037	Food Service	Dinner	Military	28	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density.
393	22-Jun-00	22-Jun-00	8:40 PM	JAG	40	15.8	0	0	0	3.914	4.037	Food Service	Dinner	Military	28	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density.
394	22-Jun-00	22-Jun-00	8:40 PM	JAG	21	10.6	0	0	0	3.386	3.130	Food Service	Dinner	Military	28	10275	Lunch waste found in dumpster with dinner waste. Volume found by taking the weight and dividing it by the calculated average material 21 density
395	22-Jun-00	22-Jun-00	8:40 PM	JAG	40	12.2	0	0	0	3.022	4.037	Food Service	Dinner	Military	28	6710	Lunch waste found in dumpster with dinner waste. Volume found by taking the weight and dividing it by the calculated average material 40 density.
396																	
397																	
398	23-Jun-00	23-Jun-00	8:50 AM	WHR	4a	33.5	17	24	6	1.417	23.647	Food Service	Breakfast	Military	29	1000	Slop
399	23-Jun-00	23-Jun-00	8:50 AM	WHR	4a	55.5	16	21	12	2.333	23.786	Food Service	Breakfast	Military	29	1000	Slop
400	23-Jun-00	23-Jun-00	8:50 AM	WHR	1	6.2	19	19	25	5.223	1.187	Food Service	Breakfast	Military	29	7370	
401	23-Jun-00	23-Jun-00	8:50 AM	WHR	40	24.6	24	18	22	6.093	4.037	Food Service	Breakfast	Military	29	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density.
402	23-Jun-00	23-Jun-00	8:50 AM	WHR	40	5	0	0	0	1.238	4.037	Food Service	Breakfast	Military	29	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density.
403	23-Jun-00	23-Jun-00	8:50 AM	WHR	40	6.2	0	0	0	1.536	4.037	Food Service	Breakfast	Military	29	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density.
404	23-Jun-00	23-Jun-00	8:50 AM	WHR	40	9.8	23	18	15	3.594	2.727	Food Service	Breakfast	Military	29	6710	
405	23-Jun-00	23-Jun-00	8:50 AM	WHR	40	11.6	23	21	12	3.354	3.458	Food Service	Breakfast	Military	29	6710	
406	23-Jun-00	23-Jun-00	8:50 AM	WHR	40	18	22	22	14	3.921	4.590	Food Service	Breakfast	Military	29	6710	
407	23-Jun-00	23-Jun-00	8:50 AM	WHR	40	14.5	21	14	22	3.743	3.874	Food Service	Breakfast	Military	29	6710	
408	23-Jun-00	23-Jun-00	8:50 AM	WHR	1	5.2	0	0	0	2.090	2.488	Food Service	Breakfast	Military	29	7370	Volume found by taking the weight and dividing it by the calculated average material 1 density
409	23-Jun-00	23-Jun-00	9:15 AM	WHR	40	16.9	25	21	19	5.773	2.928	Food Service	Breakfast	Military	30	6710	
410	23-Jun-00	23-Jun-00	9:15 AM	WHR	40	9.6	14	19	12	1.847	5.197	Food Service	Breakfast	Military	30	6710	
411	22-Jun-00	23-Jun-00	10:10 AM	WHR	13	3	19	16	10	1.759	1.705	Billet		Non-Military	31	9267	
412	22-Jun-00	23-Jun-00	10:10 AM	WHR	17	1.4	22	20	7	1.782	0.785	Billet		Military	31	17111	
413	22-Jun-00	23-Jun-00	10:10 AM	WHR	15	5.3	22	15	13	2.483	2.135	Billet		Military	31	20043	
414	22-Jun-00	23-Jun-00	10:10 AM	WHR	15	5.7	19	17	13	2.430	2.346	Billet		Military	31	20043	
415	22-Jun-00	23-Jun-00	10:10 AM	WHR	15	8.4	16	19	12	2.111	3.979	Billet		Military	31	20043	

Data Key	Date Waste Produced	Date Material Analyzed	Time	Recorder	Waste Type	Weight (lb.)	Dimensions w	l	h	Volume (cu. Ft.)	Density lb/ft3	Source	Meal	Military/ Non-Military	Ref. Sheet#	Heating Value BTU/lb.	Notes
416	22-Jun-00	23-Jun-00	10:10 AM	WHR	10	3.8	19	18	8	1.583	2.400	Billet		Military	31	7370	
417	22-Jun-00	23-Jun-00	10:10 AM	WHR	7	2.5	18	16	8	1.333	1.875	Billet		Non-Military	31	13378	
418	22-Jun-00	23-Jun-00	10:10 AM	WHR	1	5.3	17	11	24	2.597	2.041	Billet		Military	31	7370	
419	22-Jun-00	23-Jun-00	10:10 AM	WHR	27	0.3	2	3	1	0.003	86.400	Billet		Non-Military	31	1403	
420	22-Jun-00	23-Jun-00	10:10 AM	WHR	19	8.5	16	15	4	0.556	15.300	Billet		Military	31	5458	
421	22-Jun-00	23-Jun-00	10:10 AM	WHR	5	0.7	9	3	2	0.031	22.400	Billet		Non-Military	31	0	
422	22-Jun-00	23-Jun-00	10:10 AM	WHR	24	0.1	3	2	0.5	0.002	57.600	Billet		Military	31	9910	
423	22-Jun-00	23-Jun-00	10:10 AM	WHR	22	0.05	11	3	0.25	0.005	10.473	Billet		Military	31	7866	
424	22-Jun-00	23-Jun-00	10:10 AM	WHR	3	1.4	12	12	4	0.333	4.200	Billet		Military	31	7974	
425	22-Jun-00	23-Jun-00	10:10 AM	WHR	23	1.1	9	8	3	0.125	8.800	Billet		Military	31	11019	
426	22-Jun-00	23-Jun-00	10:10 AM	WHR	12	0.8	12	7	1	0.049	16.457	Billet		Military	31	8491	
427	22-Jun-00	23-Jun-00	10:10 AM	WHR	8	0.2	3	4	0.25	0.002	115.200	Billet		Military	31	3185	
428	22-Jun-00	23-Jun-00	10:10 AM	WHR	4	5	13	14	6	0.632	7.912	Billet		Military	31	2370	
429	22-Jun-00	23-Jun-00	10:10 AM	WHR	14	3.4	18	16	9	1.500	2.267	Billet		Non-Military	31	9560	
430	22-Jun-00	23-Jun-00	10:10 AM	WHR	21	1.7	16	13	5	0.602	2.825	Billet		Military	31	10275	
431	22-Jun-00	23-Jun-00	10:10 AM	WHR	4	3.1	16	12	6	0.667	4.650	Billet		Military	31	2370	
432	22-Jun-00	23-Jun-00	10:10 AM	WHR	7	1	12	11	4	0.306	3.273	Billet		Non-Military	31	13378	
433	22-Jun-00	23-Jun-00	10:10 AM	WHR	15	2	17	16	11	1.731	1.155	Billet		Military	31	20043	
434	22-Jun-00	23-Jun-00	10:10 AM	WHR	10	0.9	14	13	3	0.316	2.848	Billet		Military	31	7370	
435	22-Jun-00	23-Jun-00	10:10 AM	WHR	17	0.5	14	11	5	0.446	1.122	Billet		Military	31	17111	
436	22-Jun-00	23-Jun-00	10:10 AM	WHR	13	1.2	14	13	8	0.843	1.424	Billet		Military	31	9267	
437	22-Jun-00	23-Jun-00	10:10 AM	WHR	12	1.8	15	14	2	0.243	7.406	Billet		Military	31	8491	
438	22-Jun-00	23-Jun-00	10:10 AM	WHR	3	0.5	8	5	3	0.069	7.200	Billet		Military	31	7974	
439	22-Jun-00	23-Jun-00	10:10 AM	WHR	14	0.3	9	13	3	0.203	1.477	Billet		Military	31	9560	
440	22-Jun-00	23-Jun-00	11:00 AM	WHR	1	0.6	9	12	6	0.375	1.600	Billet		Military	32	7370	
441	22-Jun-00	23-Jun-00	11:00 AM	WHR	21	0.6	10	6	3	0.104	5.760	Billet		Non-Military	32	10275	
442	22-Jun-00	23-Jun-00	11:00 AM	WHR	4	2.7	15	14	3	0.365	7.406	Bath		Military	32	2370	
443	22-Jun-00	23-Jun-00	11:00 AM	WHR	13	1.1	15	16	6	0.833	1.320	Bath		Military	32	9267	
444	22-Jun-00	23-Jun-00	11:00 AM	WHR	10	5.9	17	21	13	2.686	2.197	Bath		Military	32	7370	
445	22-Jun-00	23-Jun-00	11:00 AM	WHR	15	1.1	14	9	4	0.292	3.771	Bath		Military	32	20043	
446	22-Jun-00	23-Jun-00	11:00 AM	WHR	17	0.3	11	9	4	0.229	1.309	Bath		Military	32	17111	
447	22-Jun-00	23-Jun-00	11:00 AM	WHR	7	0.3	10	10	4	0.231	1.296	Bath		Non-Military	32	13378	
448	22-Jun-00	23-Jun-00	11:00 AM	WHR	19	0.2	7	5	0.5	0.010	19.749	Bath		Military	32	5458	
449	22-Jun-00	23-Jun-00	11:00 AM	WHR	24	0.2	3	2	0.5	0.002	115.200	Bath		Military	32	9910	
450	22-Jun-00	23-Jun-00	11:00 AM	WHR	21	0.3	9	8	1	0.042	7.200	Bath		Military	32	10275	
451	22-Jun-00	23-Jun-00	11:00 AM	WHR	20	0.05	6	0.5	0.25	0.000	33.664	Bath		Military	32	8189	The denstiy recorded is the calculated average material 20 density.
452	22-Jun-00	23-Jun-00	11:00 AM	WHR	30	0.2	6	7	4	0.097	2.057	Bath		Military	32	5353	
453	22-Jun-00	23-Jun-00	11:00 AM	WHR	14	0.4	11	6	3	0.115	3.491	Bath		Military	32	9560	
454	22-Jun-00	23-Jun-00	11:00 AM	WHR	23	0.1	6	6	0.25	0.005	19.200	Bath		Military	32	11019	
455	22-Jun-00	23-Jun-00	11:00 AM	WHR	10	0.3	22	15	6	1.146	0.262	Food Service		Military	32	7370	
456	22-Jun-00	23-Jun-00	11:00 AM	WHR	15	0.3	8	9	3	0.125	2.400	Food Service		Military	32	20043	
457	22-Jun-00	23-Jun-00	11:00 AM	WHR	4a	0.1	6	2	0.5	0.003	28.800	Food Service		Military	32	1000	
458	22-Jun-00	23-Jun-00	11:00 AM	WHR	4	1.8	10	13	2	0.150	11.963	Admin		Military	32	2370	
459	22-Jun-00	23-Jun-00	11:00 AM	WHR	7	0.2	6	7	5	0.122	1.646	Admin		Non-Military	32	13378	
460	22-Jun-00	23-Jun-00	11:00 AM	WHR	5	0.9	5	2	6	0.035	25.920	Admin		Military	32	0	
461	22-Jun-00	23-Jun-00	11:00 AM	WHR	10	4	21	16	11	2.139	1.870	Admin		Military	32	7370	
462	22-Jun-00	23-Jun-00	11:00 AM	WHR	13	1.4	16	18	8	1.333	1.050	Admin		Non-Military	32	9267	
463	22-Jun-00	23-Jun-00	11:00 AM	WHR	15	0.9	12	15	5	0.521	1.728	Admin		Military	32	20043	
464	22-Jun-00	23-Jun-00	11:00 AM	WHR	17	0.6	20	11	5	0.637	0.943	Admin		Military	32	17111	
465	22-Jun-00	23-Jun-00	11:00 AM	WHR	14	0.2	7	11	2	0.089	2.244	Admin		Military	32	9560	
466	22-Jun-00	23-Jun-00	11:00 AM	WHR	23	0.2	11	5	0.5	0.016	12.567	Admin		Military	32	11019	
467	22-Jun-00	23-Jun-00	11:00 AM	WHR	20	0.5	12	3	2	0.042	12.000	Admin		Military	32	8189	
468	22-Jun-00	23-Jun-00	11:00 AM	WHR	21	0.4	7	10	2	0.081	4.937	Admin		Military	32	10275	
469	22-Jun-00	23-Jun-00	11:00 AM	WHR	42	9.7	19	16	8	1.407	6.892	Billet		Military	33	9326	Found in Maintenance Shell after lunch
470	22-Jun-00	23-Jun-00	11:00 AM	WHR	42	3.4	14	14	8	0.907	3.747	Billet		Military	33	9326	Found in Maintenance Shell after lunch
471	23-Jun-00			Total Dumpster Vo	Total Dumpster Volume Lunch		22	72	82			75.167					

Data Key	Date Waste Produced	Date Material Analyzed	Time	Recorder	Waste Type	Weight (lb.)	Dimensions w	l	h	Volume (cu. Ft.)	Density lb/ft3	Source	Meal	Military/ Non-Military	Ref. Sheet#	Heating Value BTU/lb.	Notes
472	23-Jun-00	23-Jun-00	2:30 PM	WHR	1	17.3	0	0	0	6.954	2.488	Food Service	Lunch	Military	34	7370	Volume found by taking the weight and dividing it by the calculated average material 1 density
473	23-Jun-00	23-Jun-00	2:30 PM	WHR	1	13.7	0	0	0	5.507	2.488	Food Service	Lunch	Military	34	7370	Volume found by taking the weight and dividing it by the calculated average material 1 density
474	23-Jun-00	23-Jun-00	2:30 PM	WHR	1	10.6	0	0	0	4.261	2.488	Food Service	Lunch	Military	34	7370	Volume found by taking the weight and dividing it by the calculated average material 1 density
475	23-Jun-00	23-Jun-00	2:30 PM	WHR	1	7.4	0	0	0	2.975	2.488	Food Service	Lunch	Military	34	7370	Volume found by taking the weight and dividing it by the calculated average material 1 density
476	23-Jun-00	23-Jun-00	2:30 PM	WHR	1	5.7	0	0	0	2.291	2.488	Food Service	Lunch	Military	34	7370	Volume found by taking the weight and dividing it by the calculated average material 1 density
477	23-Jun-00	23-Jun-00	2:30 PM	WHR	1	7.2	0	0	0	2.894	2.488	Food Service	Lunch	Military	34	7370	Volume found by taking the weight and dividing it by the calculated average material 1 density
478	23-Jun-00	23-Jun-00	2:30 PM	WHR	40	2.4	0	0	0	0.594	4.037	Food Service	Lunch	Military	34	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density.
479	23-Jun-00	23-Jun-00	2:30 PM	WHR	40	6.2	0	0	0	1.536	4.037	Food Service	Lunch	Military	34	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density.
480	23-Jun-00	23-Jun-00	2:30 PM	WHR	40	23.2	0	0	0	5.747	4.037	Food Service	Lunch	Military	34	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density.
481	23-Jun-00	23-Jun-00	2:30 PM	WHR	40	41.6	0	0	0	10.304	4.037	Food Service	Lunch	Military	34	6710	Volume found by taking the weight and dividing it by the calculated average material 40 density.

APPENDIX F – RESULTS OF HEAT OF COMBUSTION TESTING

Averaging Cone Results
Project #5517 Waste Study

SAMPLE ID	Incident Heat Flux kW/m^2	Specimen mass			Time to Ignition (s)	Duration (s)	Peak RHR/A kWm^2	Time Occurred (s)	Total HRR/A MJ/m^2	Avg Eff H Comb MJ/kg	CO Yield g/g
		Initial (g)	Loss (g)	Loss %							
1.1	50	10.8	10.5	97.22%	121	155	161.5	16	12.5	11.9	0.0487
1.2	50	10.8	10.3	95.37%	121	176	153.1	18	13.4	13	0.051
Average	**50**	**10.8**	**10.4**	**96.30%**	**121**	**165.5**	**157.3**	**17**	**12.95**	**12.45**	**0.04985**

SAMPLE ID	Incident Heat Flux kW/m^2	Specimen mass			Time to Ignition (s)	Duration (s)	Peak HRR/A kWm^2	Time Occurred (s)	Total HRR/A MJ/m^2	Avg Eff H Comb MJ/kg	CO Yield g/g
		Initial (g)	Loss (g)	Loss %							
2.1	50	95.1	80.4	84.54%	14	676	546.5	444	179.8	22.4	0.0279
2.2	50	79	66.1	83.67%	11	439	1047.1	336	157	23.7	0.0812
Average	**50**	**87.05**	**73.25**	**84.11%**	**12.5**	**557.5**	**796.8**	**390**	**168.4**	**23.05**	**0.05455**

SAMPLE ID	Incident Heat Flux kW/m^2	Specimen mass			Time to Ignition (s)	Duration (s)	Peak HRR/A kWm^2	Time Occurred (s)	Total HRR/A MJ/m^2	Avg Eff H Comb MJ/kg	CO Yield g/g
		Initial (g)	Loss (g)	Loss %							
3.1	50	11.9	11.8	99.16%	4	136	267.4	45	16.5	14	1.3235
3.2	50	11	10.4	94.55%	5	130	279.8	40	14.7	14.1	0.5906
Average	**50**	**11.45**	**11.1**	**96.85%**	**4.5**	**133**	**273.6**	**42.5**	**15.6**	**14.05**	**0.95705**

SAMPLE ID	Incident Heat Flux kW/m^2	Specimen mass			Time to Ignition (s)	Duration (s)	Peak HHR/A kWm^2	Time Occurred (s)	Total HRR/A MJ/m^2	Avg Eff H Comb MJ/kg	CO Yield g/g
		Initial (g)	Loss (g)	Loss %							
4.1	50	207	183.4	88.60%	78	2514	129.6	1756	222.8	12.1	0.0184
0	50										
Average	**50**	**207**	**183.4**	**0.885990338**	**78**	**2514**	**129.6**	**1756**	**222.8**	**12.1**	**0.0184**

SAMPLE ID	Incident Heat Flux kW/m^2	Specimen mass			Time to Ignition (s)	Duration (s)	Peak HRR/A kWm^2	Time Occurred (s)	Total HRR/A MJ/m^2	Avg Eff H Comb MJ/kg	CO Yield g/g
		Initial (g)	Loss (g)	Loss %							
5.1	50	1.8	1	55.56%	8	54	88	17	2.2	22	0.0179
5.2	50	1.5	1.3	86.67%	8	140	51.2	30	3.4	25.8	0.0891
Average	**50**	**1.65**	**1.15**	**0.711111111**	**8**	**97**	**69.6**	**23.5**	**2.8**	**23.9**	**0.0535**

SAMPLE ID	Incident Heat Flux kW/m^2	Specimen mass			Time to Ignition (s)	Duration (s)	Peak HRR/A kWm^2	Time Occurred (s)	Total HRR/A MJ/m^2	Avg Eff H Comb MJ/kg	CO Yield g/g
		Initial (g)	Loss (g)	Loss %							
6.1	50	369.8	181.5	49.1	18	2047	242.5	97	127.8	13.1	0.0355
6.2	50	309.6	154.9	50.1	14	2181	335.5	94	94.2	11.3	0.0347
Average	**50**	**339.7**	**168.2**	**49.6**	**16**	**2114**	**289**	**95.5**	**111**	**12.2**	**0.0351**

Cone Calorimeter Summary Data Sheet

Test Number and Data File: cn07135
Date: 7/13/2000
Time: 10:32
Test Operator: Ralph Ouellette

Manufacturer/Customer: U.S Army
Point of Contact: Bill Ruppert
HAI Job Number: 5517

Sample ID: 1.1
Sample Description: Lint
Sample Thickness (mm): 23
Sample # 1.1 of 2
Conditioning (if any): None

Sample Orientation: Horizontal
Holder Type: Pan
Spark Used: Yes
Applied Heat Flux(kW/m²): 50

Ignition Time (sec): 1
Flame Duration (sec): 155

Initial Sample Mass (g): 10.8
Final Sample Mass (g): 0.3
Total Mass Loss (g): 10.5
Percent Mass Loss: 97.2
Average Mass Loss Rate (g/s): 0.054
Average Specific Extinction Area (m²/kg): 1323

Average CO2 Yield (g/g): 2.7864
Average CO Yield (g/g): 0.0487
Total Heat Released (MJ/m²): 12.5
Average Effective Heat of Combustion (MJ/kg): 11.9

	60 sec	**180 sec**	**300 sec**	**Test**
Peak HRR (kW/m²)	161.5	0.0	0.0	161.5
Time of Peak (s)	16	0	0	16
Average HRR (kW/m²)	110.3	0.0	0.0	80.3

Remarks:

HUGHES ASSOCIATES INC.

Cone Calorimeter Data Sheet

Project No. 5517 Client U.

Test Date 7/13/00 Test Time 10:32 AM/PM

Test ID CN07135 Specimen ID 1.1

Specimen Description Lint

Ambient Temperature 25 F/C Ambient % RH 43 Press. 30.08 in. Hg

Conditioning – Standard or other N/A

Cure Time (if any) N/A

Specimen Mass (g) 10.8 Specimen thickness (mm) 23

Specimen Dimensions (cm) 100 X 100 Surface Area .01

Initial Mass of Specimen and Holder (g) 317.0 Spark Used Yes / No

Exposure Heat Flux (kW/m2) 50 Orientation: Horiz. / Vert

Specimen Holder: Pan ✓ Edge Frame ____ Edge Frame w/Grid ____

Cone Calibration Constant 1.1

Observations (Min: Sec)

Beginning of Test 2:00 (120) Time to Transient Ignition ____ Sustained Ignition 2:01 (121)

Blistering ____ Melting ____ Charring ____ Dripping ____

Swelling ____ Intumescing ____ Delaminating ____

Flame Out 4:36 (276) End of Test 5:36 (336) Last Scan ____

Other ____

Post Test Obs. ____

Final Mass(g) 306.5 Test Operator [signature]

Cone Calorimeter Summary Data Sheet

Test Number and Data File: cn07137
Date: 7/13/2000
Time: 10:45
Test Operator: Ralph Ouellette

Manufacturer/Customer: U.S Army
Point of Contact: Bill Ruppert
HAI Job Number: 5517

Sample ID: 1.2
Sample Description: Lint
Sample Thickness (mm): 23
Sample # 1.2 of 2
Conditioning (if any): None

Sample Orientation: Horizontal
Holder Type: Pan
Spark Used: Yes
Applied Heat Flux(kW/m^2): 50

Ignition Time (sec): 1
Flame Duration (sec): 176

Initial Sample Mass (g): 10.8
Final Sample Mass (g): 0.5
Total Mass Loss (g): 10.3
Percent Mass Loss: 95.4
Average Mass Loss Rate (g/s): 0.051
Average Specific Extinction Area (m^2/kg): 1502.3

Average CO2 Yield (g/g): 2.229
Average CO Yield (g/g): 0.0297
Total Heat Released (MJ/m^2): 13.4
Average Effective Heat of Combustion (MJ/kg): 13

	60 sec	180 sec	300 sec	Test
Peak HRR (kW/m^2)	153.1	0.0	0.0	153.1
Time of Peak (s)	18	0	0	18
Average HRR (kW/m^2)	105.3	0.0	0.0	75.7

Remarks:

HUGHES ASSOCIATES INC.

Cone Calorimeter Data Sheet

Project No. 5517 Client US Army

Test Date 7/13/08 Test Time 10:45 AM/PM

Test ID CP07137 Specimen ID 1,2

Specimen Description Lint

Ambient Temperature 25 F/C Ambient % RH 45 Press. 30.03 in. Hg

Conditioning – Standard or other

Cure Time (if any)

Specimen Mass (g) 10.8 Specimen thickness (mm)

Specimen Dimensions (cm) 100 X 100 Surface Area 2

Initial Mass of Specimen and Holder (g) 318.5 Spark Used Yes / No

Exposure Heat Flux (kW/m2) 50 Orientation: Horiz / Vert

Specimen Holder: Pan ✓ Edge Frame Edge Frame w/Grid

Cone Calibration Constant 1.1

Observations (Min: Sec)

Beginning of Test 120 2:00 Time to Transient Ignition Sustained Ignition 121 2:01

Blistering Melting Charring Dripping

Swelling Intumescing Delaminating

Flame Out 297 4:57 End of Test 357 5:57 Last Scan

Other

Post Test Obs.

Final Mass(g) 308.2 Test Operator [signature]

Cone Calorimeter Summary Data Sheet

Test Number and Data File: cn07139
Date: 7/13/2000
Time: 11:20
Test Operator: Ralph Ouellette

Manufacturer/Customer: U.S Army
Point of Contact: Bill Ruppert
HAI Job Number: 5517

Sample ID: 2.1
Sample Description: Irish Spring Soap (Bar)
Sample Thickness (mm): 12
Sample # 2.1 of 2
Conditioning (if any): None

Sample Orientation: Horizontal
Holder Type: Pan
Spark Used: Yes
Applied Heat Flux(kW/m^2): 50

Ignition Time (sec): 14
Flame Duration (sec): 676

Initial Sample Mass (g): 95.1
Final Sample Mass (g): 14.7
Total Mass Loss (g): 80.4
Percent Mass Loss: 84.5
Average Mass Loss Rate (g/s): 0.122
Average Specific Extinction Area (m^2/kg): 1940.9

Average CO_2 Yield (g/g): 2.0553
Average CO Yield (g/g): 0.0279
Total Heat Released (MJ/m^2): 179.8
Average Effective Heat of Combustion (MJ/kg): 22.4

	60 sec	**180 sec**	**300 sec**	**Test**
Peak HRR (kW/m^2)	134.7	204.0	513.2	546.5
Time of Peak (s)	58	180	285	444
Average HRR (kW/m^2)	96.5	145.8	218.2	265.4

Remarks:

HUGHES ASSOCIATES INC.
Cone Calorimeter Data Sheet

Project No. 5517 Client US

Test Date 7/13/00 Test Time 11:20 AM/PM

Test ID CN07139 Specimen ID 2.1

Specimen Description Irish Spring Soap - Bar

Ambient Temperature 75 F/C Ambient % RH 45 Press. 30.03 in. Hg

Conditioning – Standard or other N/A

Cure Time (if any) N/A

Specimen Mass (g) 95.1 Specimen thickness (mm) 12

Specimen Dimensions (cm) 10 X 10 Surface Area ______

Initial Mass of Specimen and Holder (g) 443.5 Spark Used Yes / No

Exposure Heat Flux (kW/m2) 50 Orientation: Horiz / Vert

Specimen Holder: Pan ✓ Edge Frame ______ Edge Frame w/Grid ______

Cone Calibration Constant 1.1

Observations (Min: Sec)

Beginning of Test 2:00 (120) Time to Transient Ignition 2:12 (132) Sustained Ignition 2:14 (134)

Blistering ______ Melting 2:02 (122) Charring ______ Dripping ______

Swelling ______ Intumescing ______ Delaminating ______

Flame Out 13:30 (810) End of Test 14:30 (870) Last Scan ______

Other Overflow 4:30

Post Test Obs. ______

Final Mass(g) 363.1 Test Operator [signature]

845
-203

Cone Calorimeter Summary Data Sheet

Test Number and Data File: cn071311
Date: 7/13/2000
Time: 11:50
Test Operator: Ralph Ouellette

Manufacturer/Customer: U.S Army
Point of Contact: Bill Ruppert
HAI Job Number: 5517

Sample ID: 2.2
Sample Description: Irish Spring Soap (Bar)
Sample Thickness (mm): 12
Sample # 2.2 of 2
Conditioning (if any): None

Sample Orientation: Horizontal
Holder Type: Pan
Spark Used: Yes
Applied Heat Flux(kW/m^2): 50

Ignition Time (sec): 11
Flame Duration (sec): 439

Initial Sample Mass (g): 79
Final Sample Mass (g): 12.9
Total Mass Loss (g): 66.1
Percent Mass Loss: 83.7
Average Mass Loss Rate (g/s): 0.151
Average Specific Extinction Area (m^2/kg): 3287.3

Average CO2 Yield (g/g): 3.7277
Average CO Yield (g/g): 0.0812
Total Heat Released (MJ/m^2): 157
Average Effective Heat of Combustion (MJ/kg): 23.7

	60 sec	**180 sec**	**300 sec**	**Test**
Peak HRR (kW/m^2)	143.2	246.0	549.1	1047.1
Time of Peak (s)	59	180	297	336
Average HRR (kW/m^2)	100.6	155.4	258.7	356.7

Remarks:

HUGHES ASSOCIATES INC.
Cone Calorimeter Data Sheet

Project No. 5517 Client U.S. Army

Test Date 7/13/06 Test Time ______ AM/PM

Test ID CD071311 Specimen ID 22

Specimen Description 5- Irish Spring Soap - Bar

Ambient Temperature 75 F/C Ambient % RH 45 Press. 30.03 in. Hg

Conditioning – Standard or other N/A

Cure Time (if any) N/A

Specimen Mass (g) 79.0 Specimen thickness (mm) 12

Specimen Dimensions (cm) 100 X 100 Surface Area ______

Initial Mass of Specimen and Holder (g) 420.1 Spark Used – Yes / No

Exposure Heat Flux (kW/m2) 50 Orientation: Horiz. / Vert

Specimen Holder: Pan ✓ Edge Frame ______ Edge Frame w/Grid ______

Cone Calibration Constant 1.1

Observations (Min: Sec)

Beginning of Test 2:00 (120) Time to Transient Ignition 2:09 (129) Sustained Ignition 2:11 (131)

Blistering ______ Melting ______ Charring ______ Dripping ______

Swelling ______ Intumescing ______ Delaminating ______

Flame Out 9:30 (570) End of Test 10:30 (630) Last Scan ______

Other ______

Post Test Obs. ______

Final Mass(g) 354.0 Test Operator [signature]

Cone Calorimeter Summary Data Sheet

Test Number and Data File: cn071313
Date: 7/13/2000
Time: 12:59
Test Operator: Ralph Ouellette

Manufacturer/Customer: U.S. Army
Point of Contact: Bill Ruppert
HAI Job Number: 5517

Sample ID: 3.1
Sample Description: Cigarette Butts
Sample Thickness (mm): 8
Sample # 3.1 of 2
Conditioning (if any): None

Sample Orientation: Horizontal
Holder Type: Pan
Spark Used: Yes
Applied Heat Flux(kW/m²): 50

Ignition Time (sec): 4
Flame Duration (sec): 136

Initial Sample Mass (g): 11.9
Final Sample Mass (g): 0.1
Total Mass Loss (g): 11.8
Percent Mass Loss: 99.2
Average Mass Loss Rate (g/s): 0.069
Average Specific Extinction Area (m²/kg): 1891.9

Average CO2 Yield (g/g): 11.4358
Average CO Yield (g/g): 1.3235
Total Heat Released (MJ/m²): 16.5
Average Effective Heat of Combustion (MJ/kg): 14

	60 sec	**180 sec**	**300 sec**	**Test**
Peak HRR (kW/m²)	267.4	0.0	0.0	267.4
Time of Peak (s)	45	0	0	45
Average HRR (kW/m²)	195.7	0.0	0.0	119.8

Remarks:

HUGHES ASSOCIATES INC.

Cone Calorimeter Data Sheet

Project No. 55-17 Client U.S. Army

Test Date 7-13-00 Test Time 12:59 AM/PM

Test ID CN071313 Specimen ID 3.1

Specimen Description Cigarette Butts

Ambient Temperature 24 F/C Ambient % RH 46 Press. 30.03 in. Hg

Conditioning – Standard or other

Cure Time (if any)

Specimen Mass (g) 11.9 Specimen thickness (mm) 8

Specimen Dimensions (cm) 10 X 10 Surface Area

Initial Mass of Specimen and Holder (g) 373.3 Spark Used Yes / No

Exposure Heat Flux (kW/m2) 50 Orientation: Horiz. / Vert

Specimen Holder: Pan ✓ Edge Frame ✓ Edge Frame w/Grid

Cone Calibration Constant 1.1

Observations (Min: Sec)

Beginning of Test 2'00 (120) Time to Transient Ignition ____ Sustained Ignition 2'04 (124)

Blistering ____ Melting ____ Charring ____ Dripping ____

Swelling ____ Intumescing ____ Delaminating ____

Flame Out 4'20 (260) End of Test 5'20 (320) Last Scan ____

Other

Post Test Obs.

Final Mass(g) 361.5 Test Operator [signature]

Cone Calorimeter Summary Data Sheet

Test Number and Data File: cn071315
Date: 7/13/2000
Time: 1:34
Test Operator: Ralph Ouellette

Manufacturer/Customer: U.S. Army
Point of Contact: Bill Ruppert
HAI Job Number: 5517

Sample ID: 3.2
Sample Description: Cigarette Butts
Sample Thickness (mm): 8
Sample # 3.2 of 2
Conditioning (if any): None

Sample Orientation: Horizontal
Holder Type: Pan
Spark Used: Yes
Applied Heat Flux(kW/m^2): 50

Ignition Time (sec): 5
Flame Duration (sec): 130

Initial Sample Mass (g): 11
Final Sample Mass (g): 0.6
Total Mass Loss (g): 10.4
Percent Mass Loss: 94.5
Average Mass Loss Rate (g/s): 0.067
Average Specific Extinction Area (m^2/kg): 2131.8

Average CO_2 Yield (g/g): 6.8938
Average CO Yield (g/g): 0.5906
Total Heat Released (MJ/m^2): 14.7
Average Effective Heat of Combustion (MJ/kg): 14.1

	60 sec	**180 sec**	**300 sec**	**Test**
Peak HRR (kW/m^2)	279.8	0.0	0.0	279.8
Time of Peak (s)	40	0	0	40
Average HRR (kW/m^2)	187.7	0.0	0.0	111.7

Remarks:

HUGHES ASSOCIATES INC.
Cone Calorimeter Data Sheet

Project No. 5517 Client US Army

Test Date 7/13/00 Test Time 1:34 AM/PM

Test ID CN071315 Specimen ID 3.2

Specimen Description Cigarette Butts

Ambient Temperature 75 F/C Ambient % RH 44 Press. 30.03 in. Hg

Conditioning – Standard or other N/A

Cure Time (if any) N/A

Specimen Mass (g) 11 Specimen thickness (mm) 8

Specimen Dimensions (cm) 10 X 10 Surface Area .01

Initial Mass of Specimen and Holder (g) 372.1 Spark Used Yes / No

Exposure Heat Flux (kW/m2) 50 Orientation Horiz / Vert

Specimen Holder: Pan ✓ Edge Frame ___ Edge Frame w/Grid ___

Cone Calibration Constant 1.1

Observations (Min: Sec)

Beginning of Test 2:00 120 Time to Transient Ignition ___ Sustained Ignition 2:05 125

Blistering ___ Melting ___ Charring ___ Dripping ___

Swelling ___ Intumescing ___ Delaminating ___

Flame Out 4:15 255 End of Test 5:15 315 Last Scan ___

Other ___

Post Test Obs. ___

Final Mass(g) 361.7 Test Operator [signature]

Cone Calorimeter Summary Data Sheet

Test Number and Data File: cn071317
Date: 7/13/2000
Time: 2:33
Test Operator: Ralph Ouellette

Manufacturer/Customer: U.S. Army
Point of Contact: Bill Ruppert
HAI Job Number: 5517

Sample ID: 4.1
Sample Description: MRE food
Sample Thickness (mm): 20
Sample # 4.1 of 1
Conditioning (if any): None

Sample Orientation: Horizontal
Holder Type: Pan
Spark Used: Yes
Applied Heat Flux(kW/m^2): 50

Ignition Time (sec): 78
Flame Duration (sec): 2514

Initial Sample Mass (g): 207
Final Sample Mass (g): 23.6
Total Mass Loss (g): 183.4
Percent Mass Loss: 88.6
Average Mass Loss Rate (g/s): 0.069
Average Specific Extinction Area (m^2/kg): 46.3

Average CO2 Yield (g/g): 1.3023
Average CO Yield (g/g): 0.0184
Total Heat Released (MJ/m^2): 222.8
Average Effective Heat of Combustion (MJ/kg): 12.1

	60 sec	**180 sec**	**300 sec**	**Test**
Peak HRR (kW/m^2)	78.7	86.7	86.7	129.6
Time of Peak (s)	54	89	89	1756
Average HRR (kW/m^2)	54.9	60.6	54.9	88.5

Remarks:

HUGHES ASSOCIATES INC.
Cone Calorimeter Data Sheet

Project No. 5517 Client US ARMY

Test Date 7-13-00 Test Time 2:33 AM/PM

Test ID CN071317 Specimen ID 4.1

Specimen Description -MRE- Food mix Chili & MAC
Peanut Butter CoCA Powder VEG Crackers, Poundcake

Ambient Temperature 25 F/C Ambient % RH 45 Press. 30.03 in. Hg

Conditioning – Standard or other ______

Cure Time (if any) ______

Specimen Mass (g) 207 Specimen thickness (mm) 20

Specimen Dimensions (cm) 10 X 10 Surface Area .01

Initial Mass of Specimen and Holder (g) 514.8 Spark Used Yes / No

Exposure Heat Flux (kW/m2) 50 Orientation: Horiz. / Vert

Specimen Holder: Pan ______ Edge Frame ______ Edge Frame w/Grid ______

Cone Calibration Constant ______

Observations (Min: Sec)

Beginning of Test 3:00 (180) Time to Transient Ignition ______ Sustained Ignition 4:18 (258)

Blistering ______ Melting ______ Charring 3:15 Dripping ______

Swelling ______ Intumescing ______ Delaminating ______

Flame Out 46:12 (2772) End of Test 47:12 (2832) Last Scan ______

Other Lit front Right Corner

Post Test Obs. ______

Final Mass(g) 331.4 Test Operator [signature]

Cone Calorimeter Summary Data Sheet

Test Number and Data File: cn071320
Date: 7/13/2000
Time: 2:53
Test Operator: Ralph Ouellette

Manufacturer/Customer: U.S. Army
Point of Contact: Bill Ruppert
HAI Job Number: 5517

Sample ID: 5.1
Sample Description: MRE food packaging material
Sample Thickness (mm): 0.2
Sample # 5.1 of 2
Conditioning (if any): None

Sample Orientation: Horizontal
Holder Type: Pan
Spark Used: Yes
Applied Heat Flux(kW/m²): 50

Ignition Time (sec): 8
Flame Duration (sec): 54

Initial Sample Mass (g): 1.8
Final Sample Mass (g): 0.8
Total Mass Loss (g): 1
Percent Mass Loss: 55.6
Average Mass Loss Rate (g/s): 0.01
Average Specific Extinction Area (m²/kg): 5038.9

Average CO2 Yield (g/g): 1.7735
Average CO Yield (g/g): 0.0179
Total Heat Released (MJ/m²): 2.2
Average Effective Heat of Combustion (MJ/kg): 22

	60 sec	**180 sec**	**300 sec**	**Test**
Peak HRR (kW/m²)	88.0	0.0	0.0	88.0
Time of Peak (s)	17	0	0	17
Average HRR (kW/m²)	39.6	0.0	0.0	39.6

Remarks:

HUGHES ASSOCIATES INC.
Cone Calorimeter Data Sheet

Project No. 5517 Client US Army

Test Date 7-13-00 Test Time 2:53 AM/PM

Test ID CM071320 Specimen ID 5.1

Specimen Description MPE Package Material

Ambient Temperature 25 F/C Ambient % RH 43 Press. 30.03 in. Hg

Conditioning – Standard or other N/A

Cure Time (if any) N/A

Specimen Mass (g) 1.8 Specimen thickness (mm) .2

Specimen Dimensions (cm) 10 X 10 Surface Area .01

Initial Mass of Specimen and Holder (g) 394.4 Spark Used Yes / No

Exposure Heat Flux (kW/m2) 50 Orientation: Horiz. / Vert

Specimen Holder: Pan ✓ Edge Frame ______ Edge Frame w/Grid ______

Cone Calibration Constant 1.1

Observations (Min: Sec)

Beginning of Test 120 2:00 Time to Transient Ignition ______ Sustained Ignition 128 2:08

Blistering ______ Melting ______ Charring ______ Dripping ______

Swelling ______ Intumescing ______ Delaminating ______

Flame Out 182 3:02 End of Test 242 4:02 Last Scan ______

Other ______

Post Test Obs. ______

Final Mass(g) 393.4 Test Operator [signature]

Cone Calorimeter Summary Data Sheet

Test Number and Data File: cn071321
Date: 7/13/2000
Time: 3:04
Test Operator: Ralph Ouellette

Manufacturer/Customer: U.S. Army
Point of Contact: Bill Ruppert
HAI Job Number: 5517

Sample ID: 5.2
Sample Description: MRE food packaging material
Sample Thickness (mm): 0.2
Sample # 5.2 of 2
Conditioning (if any): None

Sample Orientation: Horizontal
Holder Type: Pan
Spark Used: Yes
Applied Heat Flux(kW/m²): 50

Ignition Time (sec): 8
Flame Duration (sec): 140

Initial Sample Mass (g): 1.5
Final Sample Mass (g): 0.2
Total Mass Loss (g): 1.3
Percent Mass Loss: 86.7
Average Mass Loss Rate (g/s): 0.01
Average Specific Extinction Area (m²/kg): 4027

Average CO2 Yield (g/g): 3.8666
Average CO Yield (g/g): 0.0891
Total Heat Released (MJ/m²): 3.4
Average Effective Heat of Combustion (MJ/kg): 25.8

	60 sec	180 sec	300 sec	Test
Peak HRR (kW/m²)	51.2	0.0	0.0	51.2
Time of Peak (s)	30	0	0	30
Average HRR (kW/m²)	38.8	0.0	0.0	23.7

Remarks:

HUGHES ASSOCIATES INC.
Cone Calorimeter Data Sheet

Project No. 5517 Client US Army

Test Date 7-13-00 Test Time 3:04 AM/PM

Test ID CN071321 Specimen ID 5.2

Specimen Description MRE Pakageing Material

Ambient Temperature 75 F/C Ambient % RH 45 Press. 30.03 in. Hg

Conditioning – Standard or other N/A

Cure Time (if any) N/A

Specimen Mass (g) 1.5 Specimen thickness (mm) .2

Specimen Dimensions (cm) 10 X 10 Surface Area

Initial Mass of Specimen and Holder (g) 394.3 Spark Used Yes / No

Exposure Heat Flux (kW/m2) 50 Orientation: Horiz. / Vert

Specimen Holder: Pan ✓ Edge Frame ✓ Edge Frame w/Grid

Cone Calibration Constant 1.1

Observations (Min: Sec)

Beginning of Test 2:00 (120 sec) Time to Transient Ignition ____ Sustained Ignition 2:08 (128 sec)

Blistering ____ Melting ____ Charring ____ Dripping ____

Swelling ____ Intumescing ____ Delaminating ____

Flame Out 4:28 (268 sec) End of Test 5:28 (328 sec) Last Scan ____

Other ____

Post Test Obs. ____

Final Mass(g) 393.0 Test Operator [signature]

Cone Calorimeter Summary Data Sheet

Test Number and Data File: cn07208
Date: 7/20/2000
Time: 1:22
Test Operator: Ralph Ouellette

Manufacturer/Customer: U.S. Army
Point of Contact: Bill Ruppert
HAI Job Number: 5517

Sample ID: 6.1
Sample Description: 1/2 MRE Meal #10 (Ham and White Rice)
Sample Thickness (mm): 69.85
Sample # 6.1 of 2
Conditioning (if any): None

Sample Orientation: Horizontal
Holder Type: Pan
Spark Used: Yes
Applied Heat Flux(kW/m²): 50

Ignition Time (sec): 18
Flame Duration (sec): 2047

Initial Sample Mass (g): 369.8
Final Sample Mass (g): 188.3
Total Mass Loss (g): 181.5
Percent Mass Loss: 49.1
Average Mass Loss Rate (g/s): 0.096
Average Specific Extinction Area (m²/kg): 47.2

Average CO2 Yield (g/g): 1.4121
Average CO Yield (g/g): 0.0355
Total Heat Released (MJ/m²): 127.8
Average Effective Heat of Combustion (MJ/kg): 13.1

	60 sec	**180 sec**	**300 sec**	**Test**
Peak HRR (kW/m²)	220.7	242.5	242.5	242.5
Time of Peak (s)	59	97	97	97
Average HRR (kW/m²)	148.3	190.5	178.3	62.4

Remarks:

HUGHES ASSOCIATES INC.
Cone Calorimeter Data Sheet

Project No. 5517 Client U.S. Army

Test Date 7-20-00 Test Time 1:22 AM/PM

Test ID CN07208 Specimen ID 6.1

Specimen Description MRE - 1/2 Pack Meal #10 Ham & Rice

Ambient Temperature 25 F/C Ambient % RH 47 Press 29.89 in. Hg

Conditioning – Standard or other Cut materials in half. Removed Heating Pouch

Cure Time (if any) N/A

Specimen Mass (g) 369.8 Specimen thickness (mm) 69.85

Specimen Dimensions (cm) 13.97 x 13.335 Surface Area 186.29 cm^2 0.0186 m^2

Initial Mass of Specimen and Holder (g) 692.8 Spark Used – Yes / No

Exposure Heat Flux (kW/m2) 50 Orientation: Horiz. / Vert

Specimen Holder: Pan ✓ Edge Frame ______ Edge Frame w/Grid ______

Cone Calibration Constant 1.48

Observations (Min: Sec)

Beginning of Test 2:00 Time to Transient Ignition ______ Sustained Ignition 2:18

Blistering ______ Melting ______ Charring ______ Dripping ______

Swelling ______ Intumescing ______ Delaminating ______

Flame Out 36:25 (2185) End of Test 37:25 (2245) Last Scan ______

Other ______

Post Test Obs. ______

Final Mass(g) 511.3 Test Operator ______

Cone Calorimeter Summary Data Sheet

Test Number and Data File: cn072010
Date: 7/20/2000
Time: 2:21
Test Operator: Ralph Ouellette

Manufacturer/Customer: U.S. Army
Point of Contact: Bill Ruppert
HAI Job Number: 5517

Sample ID: 6.2
Sample Description: 1/2 MRE Meal #10 (Ham and White Rice)
Sample Thickness (mm): 69.85
Sample # 6.2 of 2
Conditioning (if any): None

Sample Orientation: Horizontal
Holder Type: Pan
Spark Used: Yes
Applied Heat Flux(kW/m²): 50

Ignition Time (sec): 14
Flame Duration (sec): 2181

Initial Sample Mass (g): 309.3
Final Sample Mass (g): 154.4
Total Mass Loss (g): 154.9
Percent Mass Loss: 50.1
Average Mass Loss Rate (g/s): 0.072
Average Specific Extinction Area (m²/kg): 61.9

Average CO2 Yield (g/g): 2.9769
Average CO Yield (g/g): 0.0347
Total Heat Released (MJ/m²): 94.2
Average Effective Heat of Combustion (MJ/kg): 11.3

	60 sec	180 sec	300 sec	Test
Peak HRR (kW/m²)	329.9	335.5	335.5	335.5
Time of Peak (s)	47	94	94	94
Average HRR (kW/m²)	224.2	235.2	172.3	43.2

Remarks:

HUGHES ASSOCIATES INC.
Cone Calorimeter Data Sheet

Project No. 5517 Client U.S. Army

Test Date 7-20-00 Test Time 2:21 AM/PM

Test ID CN072010 Specimen ID 6.2

Specimen Description 1/2 of A MRE Meal #10
Removed Heating Pouch other half of Test #6.1

Ambient Temperature 25 F/C Ambient % RH 45 Press 29.89 in. Hg

Conditioning – Standard or other ~~N/A~~ Cut material in Half

Cure Time (if any) N/A

Specimen Mass (g) 309.3 Specimen thickness (mm) 69.85

Specimen Dimensions (cm) 13.97 X 13.97 Surface Area .0186

Initial Mass of Specimen and Holder (g) 632.4 Spark Used – Yes / No

Exposure Heat Flux (kW/m2) ____ Orientation: Horiz. / Vert

Specimen Holder: Pan ____ Edge Frame ____ Edge Frame w/Grid ____

Cone Calibration Constant 1.49

Observations (Min: Sec)

Beginning of Test 2:00 Time to Transient Ignition ____ Sustained Ignition 2:14

Blistering ____ Melting ____ Charring ____ Dripping ____

Swelling ____ Intumescing ____ Delaminating ____

Flame Out 38:35 (2315) End of Test 39:35 (2375) Last Scan ____

Other ____

Post Test Obs. ____

Final Mass(g) 477.5 Test Operator ____

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APPENDIX G – CALCULATIONS

TRASH AND KITCHEN WASTE CALCULATIONS

This Appendix shows the calculations performed to derive the calculations in the Results Section (Section 3) and Analysis Section (Section 4) of this report. Most of the calculations used to convert the Raw Data in Appendices C, D, and E to the Results Section are simple addition of weights and volumes for each category, and are not covered in this Appendix.

G-1 RESULTS SECTION CALCULATIONS

Calculation 1:

Overall Volume and Weight of Kitchen Waste and Trash

The overall volume and weight calculated by adding all of the data, both measured and calculated, from the entire study period. The following formula was used:

	Characterized Trash	(Table G-1)
	Trash Not Characterized	(Table G-2)
	Kitchen Waste	(Table G-3)
	Dining Area Waste	(Table G-4)
+	Dumpster Waste Not Characterized	(Table G-5)
	Overall Weight	(Table G-6)

Calculation 1a:

Weight and Volume of Characterized Trash from Admin., Billeting, and Bath Areas

The Characterized Trash totals are shown in Table G-1. Both the weight and volume on this table were measured. The density was calculated by dividing the weight by the volume.

Calculation 1b:

Heat of Combustion of Material Category 42 (in Table G-2)

Material Category 42, Billeting Area Waste, is developed from the weighed, measured, and characterized billeting waste from the entire study.

The characteristics of Billeting Area Waste are calculated in Table G-2. This table also estimates the weight and volume of two bags of trash not characterized from the billeting area. These bags were found on the last day of the study after the team had packed up all of its equipment, but were assumed to be generated on the 22nd.

The estimates in Table G-2 are based on the measured weight of the two bags multiplied by the weight percentages of each Material Category for the rest of the billeting area waste. An example of this calculation follows below.

Table G-1. Characterized Trash from Admin., Billeting, and Bath Areas

	Material Category	Total Weight lbs.	Total Volume ft^3	Density lb/ft^3
1	Cardboard	56.9	23.9	2.4
2	Fabric – Acrylic	0.0	0.0	0.0
3	Fabric – Cotton	11.1	2.2	5.1
4	Food	69.8	7.7	9.0
4a	Slop	0.0	0.0	0.0
5	Glass	10.2	0.5	20.5
6	Leather	0.0	0.0	0.0
7	Metal – Aluminum	21.4	13.9	1.5
8	Metal – Iron	15.7	0.8	19.7
9	Metal – Magnesium	0.0	0.0	0.0
10	Paper – Brown	81.4	32.7	2.5
11	Paper – Magazine	4.1	0.1	50.5
12	Paper – Newsprint	5.5	0.8	6.9
13	Paper – Wax	31.6	19.8	1.6
14	Plastic – Polyethylene Terephthalate	39.0	13.0	3.0
15	Plastic – Polyethylene, Polypropylene	84.1	44.1	1.9
16	Plastic – Polyvinyl Chloride	0.2	0.0	10.8
17	Plastic – Polystyrene	13.2	19.0	0.7
18	Tire Rubber	0.0	0.0	0.0
19	Unopened MREs	40.2	4.0	10.0
20	Wood	1.0	0.1	18.0
21	Opened MRE Inner Packaging	16.9	7.5	2.3
22	Neoprene	1.7	0.2	9.7
23	MRE Heaters	6.8	1.1	6.4
24	Soap	2.2	0.0	49.9
25	Nylon	2.9	0.6	5.2
26	Rock	0.2	0.2	1.3
27	Batteries	1.7	0.0	138.0
28	Cigarette Waste	8.2	1.3	6.3
29	Latex	0.1	0.0	5.8
30	Lint	0.2	0.1	2.1
43	Paint Can	3.2	0.1	23.9

In Tables G-2 to G-5, Material Categories that were not found have been omitted from the table completely. For example, in Table G-2, categories 2,4a, 6, 9,18, 29, and 30 were not found in billeting area waste, and are not listed in the table.

Data Given:

The Billeting Area Weights shown in column 3 (summed from Appendix E)
The Heats of Combustion shown in Column 5 (From Table 1.2)

Find:

The average heat of combustion of the Billeting Waste (Table G-2, Column 6).

Step 1: Sum all of the Material Categories:

Σ Column 3 = 410.0 lbs

Step 2: Calculate the weight percentage of individual Material Categories:

Using Cardboard as an example:

$$\frac{43.0}{410.0} = 10.47\%$$ (Values in Table G-2 are rounded)

Step 3: Calculate the Heat of Combustion Contribution of individual Material Categories

$$10.47\% \times 7370 \frac{BTU}{lb.} = 772 \frac{BTU}{lb.}$$

Step 4: Calculate the average heat of combustion of the Billeting Waste

Σ Column 6 = 9326 BTU/lb. Answer

Calculation 1c:

Estimated Weight and Volume of Two Billeting Area Bags (Table G-2, Columns 7 & 9)

Data Given:

Weight of two individual bags generated on 6/22/00 (from Appendix E)
= 13.1 lbs
Weight Percentages of Billeting Waste (Column 4 of Table G-2)
The Density of Billeting Waste Material Categories (from Appendix E)

Find:

The Weight and Volume of individual Material Categories in two bags.

Step 1:

Estimate the weights of the individual Material Categories.
Using Cardboard as an example:

$$10.47\% \times 13.1 = 1.4\ lbs.$$ Answer

Table G-2. Estimated Contents of Material Category 42, Billeting Waste

#	Material Category	Total Billeting Waste Weight[1] lbs.	Weight Percentage %	Heating Value BTU/lb.	Heat of Combustion Contribution BTU/lb.	Estimated Weight in Uncharacterized Bags lbs.	Average Billeting Waste Density lbs./ft^3	Estimated Volume in 2 Bags ft^3
1	Cardboard	43.0	10	7370	772	1.4	2.5	0.55
3	Fabric – Cotton	7.9	2	7974	154	0.3	6.3	0.04
4	Food	53.8	13	2370	311	1.7	11.6	0.15
5	Glass	8.5	2	0	0	0.3	23.5	0.01
7	Metal – Aluminum	16.5	4	13378	538	0.5	2.1	0.25
8	Metal – Iron	15.7	4	3185	122	0.5	104.6	<0.01
10	Paper – Brown	34.0	8	7370	611	1.1	2.6	0.42
11	Paper – Magazine	4.1	1	5474	55	0.1	49.0	0.00
12	Paper – Newsprint	5.1	1	8491	106	0.2	8.1	0.02
13	Paper – Wax	23.8	6	9267	538	0.8	2.2	0.34
14	Plastic – Polyethylene Terephthalate	31.3	8	9560	729	1.0	3.7	0.27
15	Plastic – Polyethylene, Polypropylene	72.1	18	20043	3522	2.3	1.9	1.20
16	Plastic – Polyvinyl Chloride	0.1	<1	7737	2	0.0	10.8	<0.01
17	Plastic – Polystyrene	8.9	2	17111	371	0.3	0.9	0.31
19	Unopened MREs	36.7	9	5458	488	1.2	12.6	0.09
20	Wood	0.5	<1	8189	9	0.1	33.7	0.00
21	Opened MRE Inner Packaging	14.6	4	10275	366	0.5	3.1	0.15
22	Neoprene	1.2	<1	7866	22	0.0	12.7	0.00
23	MRE Heaters	5.8	1	11019	156	0.2	9.9	0.02
24	Soap	0.8	<1	9910	19	0.0	65.5	<0.01
25	Nylon	2.9	<1	13663	97	0.1	5.2	0.02
26	Rock	0.2	<1	0	0	0.0	172.8	<0.01
27	Batteries	1.7	<1	1403	6	0.1	149.8	<0.01
28	Cigarette Waste	8.2	2	6040	121	0.3	6.5	0.04
40	Dining Area Waste[2]	13.1	3	6710	214	0.4	4.0	0.10
	Heat of Combustion for Material Category 42 (Billeting Area Waste)				9326			

1. Includes billeting wastes from entire study period.
2. Dining Area Waste is found in the billeting area waste when it is brought back to the billets after meals. This category is broken down further below.

Step 2:

Estimate the volume of the individual Material Categories.
Using Cardboard as an example:

$$\frac{1.4\ lb.}{2.5\ \dfrac{lb.}{ft^3}} = 0.55\ ft^3$$

Answer

Calculation 1d:

Weight and Volume of Unopened Bags of Kitchen Waste

The measured weights of unopened bags of kitchen waste are shown in Table G-3. Unopened bags were categorized only if they contained a majority of one type of waste. For example, if a bag contained all paper towels, it was characterized as Material Category 10, Paper – Brown. However, if the bag contained a mixture of waste clearly from the dining area (i.e., containing plastic utensils, plates, food, napkins, etc.) it was categorized as Material Category 40. Both the weight and volume on this table were measured. The density was calculated by dividing the weight by the volume.

Table G-3. Kitchen Waste Totals 6/18–6/22

Material Category		Total Weight lbs.	Total Volume ft^3	Density lb/ft^3
1	Cardboard	318.3	128.6	2.5
4a	Slop	494.0	11.5	43.1
7	Metal – Aluminum	0.1	0.1	1.4
8	Metal – Iron	0.8	0.0	104.6
10	Paper – Brown	17.9	3.1	5.7
13	Paper – Wax	0.8	0.4	2.2
14	Plastic – Polyethylene Terephthalate	0.1	0.0	11.5
15	Plastic – Polyethylene, Polypropylene	13.1	6.9	1.9
17	Plastic – Polystyrene	11.1	12.1	0.9
19	Unopened MREs	15.1	1.2	12.6
20	Wood	0.0	0.0	0.0
21	Opened MRE Inner Packaging	79.3	25.3	3.1
23	MRE Heaters	4.6	0.5	9.9
40	Dining Area Waste	1425.6	350.6	0.0

Calculation 1e: Heat of Combustion for Dining Area Waste

Material Category 40, Dining Area Waste, is developed from the weighed, measured, and characterized putrescible kitchen waste from two meals, as described in section 2.4, bullet 2. The composition of Material Category 40 was used as a representative composition to estimate the weight and volume of the other Material Categories in kitchen waste from the uncharacterized meals (Table G-3), including the dining area waste left unweighed in the dumpster on the 18th (Table G-4). The characteristics of Dining Area Waste are calculated in Table G-2. Examples of these calculations are shown below.

Data Given:

The Dining Area Waste Weights Shown in column 3 (summed from Appendix E)
The Dining Area Waste Volumes Shown in column 3 (summed from Appendix E)
The Heats of Combustion shown in Column 5 (From Table 1.2)

Find:
The average heat of combustion of the Dining Area Waste (Table G-4, Column 6)

Step 1: Sum all of the Material Categories:
Σ Column 3 = 99.2 lbs

Step 2: Calculate the weight percentage of individual Material Categories:
Using Cardboard as an example:

$$\frac{2.9\ lbs.}{99.2\ lbs.} = 3\%$$ (Values in Table G-4 are rounded)

Step 3: Calculate the Heat of Combustion Contribution of individual Material Categories

$$3\% \times 7370 \frac{BTU}{lb.} = 215 \frac{BTU}{lb.}$$

Step 4: Calculate the average heat of combustion of the Dining Area Waste

Σ Column 6 = 6710 BTU/lb. Answer

Table G-4. Estimated Breakdown of Material Category 40, Dining Area Waste

#	Material Category	Weight From Characterized Meals lbs.	Weight Percentage %	Heating Value BTU/lb.	Heat of Combustion Contribution BTU/lb.	Estimated Weight of Uncharacterized Kitchen Waste lbs.	Average Billeting Waste Density lbs./ft^3	Estimated Volume of Uncharacterized Kitchen Waste ft^3
1	Cardboard	2.9	3	7370	215	41.7	2.5	16.8
4	Food	43.4	44	2370	1037	623.7	11.6	54.0
7	Metal – Aluminum	0.4	<1	13378	54	5.7	2.1	2.7
8	Metal – Iron	1.9	2	3185	61	27.3	104.6	0.3
10	Paper – Brown	25.8	26	7370	1917	370.8	2.6	145.2
13	Paper – Wax	11.6	12	9267	1084	166.7	2.2	74.8
14	Plastic – Polyethylene Terephthalate	0.1	<1	9560	10	1.4	3.7	0.4
15	Plastic – Polyethylene, Polypropylene	2.7	3	20043	545	38.8	1.9	20.4
17	Plastic – Polystyrene	10.3	10	17111	1777	148.0	0.9	162.2
20	Wood	<1	<1	8189	0.41	0.1		
21	Opened MRE Inner Packaging	0.1	<1	10275	10	1.4	3.1	0.4
	Heat of Combustion for Material Category 40 (Dining Area Waste)				6710			

Calculation 1f:

Estimated Weight and Volume of Dining Area Waste for Entire Study Period (Table G-4, Columns 7 & 9)

Data Given:

Weight of two individual bags generated on 6/22/00 (from Appendix E)
= 13.1 lbs
Weight Percentages of Billeting Waste (Column 4 of Table G-2)
The Density of Billeting Waste Material Categories (from Appendix E)

Find:

The Weight and Volume of individual Material Categories in two bags.

Step 1:

Estimate the weights of the individual Material Categories.
Using Cardboard as an example:

$$3\% \times 1425\ lbs. = 41.7\ lbs.$$ Answer

Step 2:

Estimate the volume of the individual Material Categories.
Using Cardboard as an example:

$$\frac{41.7\ lb.}{2.5\ \frac{lb.}{ft^3}} = 16.8\ ft^3$$ Answer

Calculation 1g:

Estimated Weight and Volume of Kitchen Waste Left in Dumpster from 6/18/00
(Table G-4, Columns 7 & 9)

As described in Section 3.2, bullet 3, the study team left a portion of the kitchen waste generated on 6/18/00 in the dumpster. This calculation estimates the weight and volume of the Material Categories left in the dumpster based on the measured overall volume and the density of the rest of the waste removed from the dumpster from that day.

Data Given:

Total Volume of Kitchen Waste Left in Dumpster (From Appendix E)
Weight and Volume of Kitchen Waste Removed from Dumpster from 6/18/00 (Appendix E)
Breakdown of Total Weight Of Waste in Kitchen Dumpster From Entire Study Period (from Appendix E)

Weight Percentage Breakdown of Material Category 40 (from Table G-4, Column 4)
The Density the individual Material Categories (from Appendix E)

Find:

Estimated Weight and Volume of Kitchen Waste Left in Dumpster from 6/18/00.

Step 1: Estimate the Total Weight of waste left in the dumpster.

Estimate the density of kitchen waste removed from dumpster from 6/18/00 by dividing the total Weight and Volume.

$$\frac{140\ lb.}{517.7\ ft^3} = 3.69\ \frac{lb.}{ft^3}$$

Multiply the measured volume (61.5 ft^3) of the waste left in the dumpster by the density.

$$61.5\ ft^3 \times 3.69 \frac{lb}{ft^3} = 227\ lb.$$

Answer.

Step 2: Estimate the weight of individual Material Categories in waste left in the dumpster.

Using Cardboard as an example:

Calculate the weight percentage of the individual Material Categories in Kitchen Waste for the entire study period:

$$\frac{391.6\ lbs.}{2733.3\ lbs.} = 14\% \text{ (Values in Table G-5 are rounded)}$$

Multiply the weight percentage of the individual Material Categories by the estimated weight of the waste left in the dumpster.

$$227\ lbs. \times 14\% = 32.6\ lbs.$$

Answer.

Step 3: Estimate the volume of individual Material Categories in waste left in the dumpster.

Divide the estimated weight by the average density of the material category.

$$\frac{32.6\ lbs.}{2.5 \frac{\text{lbs.}}{\text{ft}^3}} = 13.1\ ft^3$$

Answer.

Step 4: Estimate the Breakdown of Material Category 40 Left in the dumpster

Multiply the weight percentages of the individual Material Categories by the Estimated weight of Material Category 40 Left in the dumpster.

$134.3\ lbs. \times 3\% = 3.9\ lbs.$ Answer.

Divide the weight by the average density of the individual Material Category.

$$\frac{3.9\ lbs.}{2.5\,\frac{\text{lbs.}}{\text{ft}^3}} = 1.58\,ft^3$$ Answer.

Step 5: Total the overall weights and volumes for individual Material Categories in waste left in dumpster.

Weight – Add Columns 5 and 9

$32.6\ lbs. + 3.9\ lbs. = 36.5\ lbs.$

Volume – Add Columns 7 and 11

$13.1\ ft^3 + 1.6\ ft^3 = 14.7\ ft^3$

Calculation 1h:

Weight and Volume of Trash and Kitchen Waste for Entire Study Period.

Data Given:

Weights and Volumes from Tables G-1 through G-5

Find:

Weight and Volume of Trash and Kitchen Waste for Entire Study Period.

Using Cardboard as an example:

Weight – Add the following:
Table G-1, Column 3
Table G-2, Column 7
Table G-3, Column 3
Table G-4, Column 7
Table G-5, Column 12

56.9 lbs. + 1.4 lbs. + 318.3 lbs. + 41.7 lbs. + 36.5 lbs. = 454.7 Answer.

Volume – Add the following:
Table G-1, Column 4
Table G-2, Column 9
Table G-3, Column 5
Table G-4, Column 9
Table G-5, Column 13

$23.9\ ft^3 + 0.55\ ft^3 + 128.6\ ft^3 + 16.8\ ft^3 + 14.67\ ft^3 = 184.5\ ft^3$ Answer.

Table G-5. Estimated Weight and Volume of Kitchen Waste Left in Dumpster from 6/18/00

		Kitchen Waste for Entire Study Period		Waste Left in Dumpster Including Material Category 40			Breakdown of Material Category 40 Left in Dumpster				Totals for Material Categories 1-30	
#	Material Category	Weight lbs.[1]	Weight Percentage %	Estimated Weight lbs.	Density lbs./ft^3	Estimated Volume ft^3	Weight Percentage %	Estimated Weight lbs.	Density lbs./ft^3	Estimated Volume ft^3	Estimated Weight lbs.	Estimated Volume ft^3
1	Cardboard	391.6	14	32.6	2.5	13.090	3	3.9	2.5	1.578	36.5	14.67
4	Food	N/A	N/A	N/A	N/A	N/A	44	58.8	11.6	5.085	58.8	5.09
4a	Slop	583.1	21	48.5	37.6	1.289	N/A	N/A	N/A	N/A	48.5	1.29
7	Metal – Aluminum	0.1	<1	<0.1	2.1	0.004	<1	0.5	2.1	0.255	0.5	0.26
8	Metal – Iron	0.8	<1	0.1	104.6	0.001	2	2.6	104.6	0.0245	2.6	0.03
10	Paper – Brown	18.2	1	1.5	2.6	0.593	26	34.9	2.6	13.679	36.4	14.27
13	Paper – Wax	0.8	<1	0.1	2.2	0.030	12	15.7	2.2	7.047	15.8	7.08
14	Plastic – Polyethylene Terephthalate	0.1	<1	<0.1	3.7	0.002	<1	0.1	3.7	0.036	0.1	0.04
15	Plastic – Polyethylene, Polypropylene	13.4	<1	1.1	1.9	0.585	3	3.7	1.9	1.920	4.8	2.50
17	Plastic – Polystyrene	11.1	<1	0.9	0.9	1.007	10	13.9	0.9	15.284	14.9	16.29
19	Unopened MREs	15.1	<1	1.3	12.6	0.099	N/A	N/A	N/A	N/A	1.3	0.10
21	Opened MRE Inner Packaging	79.3	3	6.6	3.1	2.106	<1	0.1	3.1	0.043	6.7	2.15
23	MRE Heaters	4.6	<1	0.4	9.9	0.038	N/A	N/A	N/A	N/A	0.4	0.04
40	Dining Area Waste	1615.2	59	134.3	4.0	33.268	N/A	N/A	N/A	N/A	N/A	N/A
	Totals	2733.3		227.3				134.3			2733.3	63.80

1. Weights are from entire study period to give the most accurate breakdown of average material category weights.

Table G-6. Characterized Trash and Kitchen Waste from 6/18/00 to 6/22/00

Material Category		Total Weight lbs.	Total Volume ft^3	Density lb/ft^3
1	Cardboard	454.7	184.5	2.5
2	Fabric – Acrylic	None	None	None
3	Fabric – Cotton	11.4	2.2	5.1
4	Food	753.9	66.9	11.3
4a	Slop	542.5	12.7	42.6
5	Glass	10.5	0.5	20.6
6	Leather	None	None	None
7	Metal – Aluminum	28.3	17.2	1.6
8	Metal – Iron	46.9	1.1	42.8
9	Metal – Magnesium	None	None	None
10	Paper – Brown	507.8	196.9	2.6
11	Paper – Magazine	4.2	0.1	50.5
12	Paper – Newsprint	5.7	0.8	6.9
13	Paper – Wax	215.6	102.3	2.1
14	Plastic – Polyethylene Terephthalate	41.6	13.7	3.0
15	Plastic – Polyethylene, Polypropylene	143.4	75.2	1.9
16	Plastic – Polyvinyl Chloride	0.2	0.0	10.8
17	Plastic – Polystyrene	187.4	209.9	0.9
18	Tire Rubber	None	None	None
19	Unopened MREs	57.7	5.4	10.6
20	Wood	1.1	0.1	19.4
21	Opened MRE Inner Packaging	104.8	35.6	2.9
22	Neoprene	1.7	0.2	9.8
23	MRE Heaters	12.0	1.6	7.6
24	Soap	2.2	0.0	50.0
25	Nylon	3.0	0.6	5.2
26	Rock	0.2	0.2	1.4
27	Batteries	1.7	0.0	138.4
28	Cigarette Waste	8.5	1.3	6.3
29	Latex	0.1	0.0	5.8
30	Lint	0.2	0.1	2.1
43	Paint Can	3.6	0.2	15.2

Waste Kitchen Oil Calculations

Calculation 2:

Weight, Volume, and Heat of Combustion of Waste Kitchen Oil Generated

Data Given:

Table G-7. Waste Kitchen Oil Data

Date	Time	Container	Depth	Depth
			(in)	(ft)
06/20/00	9:15 AM	Drum 1	32.88	2.74
06/21/00	2:30 AM	Drum 1	32.88	2.74
06/21/00	2:30 AM	Drum 2	0.00	0
06/22/00	2:30 PM	Drum 1	33.00	2.75
06/22/00	2:30 PM	Drum 2	3.50	0.292
06/23/00	2:00 PM	Drum 1	33.00	2.75
06/23/00	2:00 PM	Drum 2	3.50	0.292

Drum Diameter = 22-3/8" = 1.865 ft.

Meals Served:

Prior to 6/20/00 = 4304
(This data was provided via telephone from Jack Hardwick on 6/28/00)
Dinner on 6/20/00 through Dinner on 6/21/00 = 478 (See Table 3.1)
(Only these meals are included because the drum was filled prior to breakfast on the 22^{nd}.)
Cooked Meals Served per soldier per day: 2 (Breakfast and Dinner)

Density of Corn Oil: 57.31 lb/ft^3 [ref]

Heat of combustion of Corn Oil: 16809 BTU/lb. [ref]

Population of a Full Force Provider = 550 + 55 = 605 persons

Find:

Find the daily Weight, Volume, and Heat of Combustion of Waste Kitchen Oil Generated per person and per full Force Provider.

Step 1: Calculate the total volume.

Total Volume = Volume on 6/21/00

$$V = \frac{\pi\, d^2}{4} \quad \times \quad Combined\ Depth$$

$$V = \frac{\pi\, 1.865^2}{4} \quad \times \quad (2.75 + 0.292) = 8.31\, ft^3$$

Step 2: Calculate to total number of meals served that contributed to the oil in the drum.

Total Meals Served = 4304 + 478 = 4782

Step 3: Calculate the volume of Waste Kitchen Oil generated per meal served.

$$\frac{\text{Volume}}{\text{Meal Served}} = \frac{8.31\ \text{ft}^3}{4782\ \text{meal}} = \frac{0.00174\ \text{ft}^3}{\text{meal}}$$

Step 4: Calculate the volume of Waste Kitchen Oil generated per person per day and for a Full Force Provider per day.

$$\frac{\text{Volume}}{\text{Person} \cdot \text{Day}} = \frac{2\ \text{meals}}{\text{person} \cdot \text{day}} \times \frac{0.00174\ \text{ft}^3}{\text{meal}} = \frac{0.0035\ \text{ft}^3}{\text{person} \cdot \text{day}}$$ Answer.

$$\frac{\text{Volume}}{\text{FP} \cdot \text{Day}} = \frac{0.0035\, ft^3}{person \cdot day} \times \frac{605\ person}{FP} = 2.1 \frac{ft^3}{FP \cdot day}$$ Answer.

Step 5: Calculate the weight of Waste Kitchen Oil generated per person per day and for a Full Force Provider per day.

$$\frac{\text{Weight}}{\text{Person} \cdot \text{Day}} = 57.31 \frac{\text{lbs.}}{\text{ft}^3} \times \frac{0.0034\ \text{ft3}}{\text{person} \cdot \text{day}} = \frac{0.20\ lbs.}{person \cdot day}$$ Answer.

$$\frac{\text{Weight}}{\text{FP} \cdot \text{Day}} = \frac{0.20\ lbs.}{person \cdot day} \times \frac{605\, person}{FP} = 121 \frac{lbs.}{FP \cdot day}$$ Answer.

Step 6: Calculate the weight of Waste Kitchen Oil generated during the study period

$$\text{Total Weight} = \frac{0.20\ lbs.}{person \cdot day} \times 478\ meal \times \frac{person \cdot day}{2\ meal} = 47.8\ lbs.$$ Answer.

Step 7: Calculate the Heat Content of Waste Kitchen Oil generated per person per day.

$$\frac{\text{Heat Content}}{\text{Person} \cdot \text{Day}} = \frac{16809\ \text{BTU}}{\text{lb.}} \times \frac{0.20\ \text{lb.}}{\text{person} \cdot \text{day}} = \frac{3400\ \text{BTU}}{\text{person} \cdot \text{day}}$$ Answer.

Step 8: Calculate the Total Heat Content of Waste Kitchen Oil generated in a Full Force Provider each day.

$$\frac{\text{Heat Content}}{\text{Force Provider} \cdot \text{Day}} = \frac{605 \text{ person}}{\text{Force Provider}} \times \frac{3400 \text{ BTU}}{\text{person} \cdot \text{day}} = \frac{2030000 \text{ BTU}}{\text{Force Provider} \cdot \text{day}}$$

Answer.

G-2 ANALYSIS SECTION CALCULATIONS

Calculation 3:

Daily Weight and Volume and Density of Material Produced at a Full Force Provider

Data Given:

Population of a Full Force Provider = 55 staff + 550 tenants = 605 soldiers

Average population per day (from Table 3.1) = 163.7 person

Study Length (Trash and Kitchen Waste were characterized from 6/18-6/23) = 5 days

Find: Daily Weight and Volume of Material Produced at a Full Force Provider
Using Cardboard as an example:

Step 1: Calculate the Daily Per Capita Weight

$$\text{Daily Per Capita Weight} = \frac{(\text{Total Weight of Material for Study})}{(\text{Average Daily Population}) \times (\text{Length of Study Periond})}$$

$$\text{Daily Per Capita Weight} = \frac{(454.7 \text{ lb})}{(163.7 \text{ person}) \times (5 \text{ days})} = 0.556 \frac{\text{lb}}{\text{person} \cdot \text{day}}$$

Step 2: Calculate the Weight of Material Produced at a Full Force Provider Daily

Weight of Cardboard = (Daily Per Capita Weight) × (Population of Full Force Provider)

Weight of Cardboard = 0.556 lb/person/day × 605 persons = 336.2 lb/day

Step 3: Calculate the Daily Per Capita Volume

$$\text{Daily Per Capita Volume} = \frac{(\text{Total Volume of Material for Study})}{(\text{Average Daily Population}) \times (\text{Length of Study Periond})}$$

$$\text{Daily Per Capita Volume} = \frac{(184.5 \text{ ft}^3)}{(163.7 \text{ person}) \times (5 \text{ days})} = 136.42 \frac{\text{ft}^3}{\text{person} \cdot \text{day}}$$

Step 4: Calculate the Volume of Material Produced at a Full Force Provider Daily

Volume of Cardboard = (Daily Per Capita Volume) × (Population of Full Force Provider)

Volume of Cardboard = 184.5 ft^3/person/day × 605 persons = 136.42 ft^3/day

Step 5: Calculate the Total Weight, Volume, and Density of all Materials Produced at a Full Force Provider Daily

Weight of all Materials = Σ Column 5 = 2330 lb/FP/day <u>Answer.</u>

Volume of all Materials = Σ Column 8 = 687 lb/FP/day <u>Answer.</u>

$$\text{Density of Material} = \frac{\text{Weight of Material}}{\text{Volume of Material}} = \frac{2330\ \frac{lb}{day}}{687\ \frac{ft^3}{day}} = 3.39\ \frac{lb}{ft^3}$$ <u>Answer.</u>

Table G-8. Heat of Combustion, Weight and Volume of Trash and Kitchen Waste

#	Material Category[1]	Heat of Combustion[1]	Total Weight Per Material	Weight of Material	Weight %	Total Volume Per Material	Volume of Material	Volume %
		BTU/lb	lb	lb/FP/day	%	ft^3	ft^3/FP/day	%
1	Cardboard	7370	454.7	336.2	14.4%	184.5	136.42	21.6%
2	Fabric – Acrylic	13232	0.0	0.0	0.0%	-	0.00	0.0%
3	Fabric – Cotton	7974	11.4	8.4	0.4%	2.2	1.64	0.3%
4	Food	2370	753.9	557.4	23.9%	66.9	49.49	22.2%
4a	Slop Food (Wet Food)	1000	542.5	401.1	17.2%	12.7	9.42	3.1%
5	Glass	0	10.5	7.7	0.3%	0.5	0.38	0.1%
6	Leather	8620	0.0	0.0	0.0%	-	0.00	0.0%
7	Metal – Aluminum	13378	28.3	20.9	0.9%	17.2	12.73	2.0%
8	Metal – Iron	3185	46.9	34.7	1.5%	1.1	0.81	1.0%
9	Metal – Magnesium	10654	0.0	0.0	0.0%	-	0.00	0.0%
10	Paper – Brown	7370	507.8	375.4	16.1%	196.9	145.53	17.3%
11	Paper – Magazine	5474	4.2	3.1	0.1%	0.1	0.06	0.0%
12	Paper – Newsprint	8491	5.7	4.2	0.2%	0.8	0.61	0.1%
13	Paper – Wax	9267	215.6	159.4	6.8%	102.3	75.66	8.2%
14	Plastic – Polyethylene Terephthalate	9560	41.6	30.8	1.3%	13.7	10.14	1.7%
15	Plastic – Polyethylene, Polypropylene	20043	143.4	106.0	4.5%	75.2	55.56	7.8%
16	Plastic – Polyvinyl Chloride	7737	0.2	0.1	0.0%	0.0	0.01	0.0%
17	Plastic – Polystyrene	17111	187.4	138.6	5.9%	209.9	155.20	9.0%
18	Tire Rubber	14051	0.0	0.0	0.0%	-	0.00	0.0%
19	Unopened MREs	5458	57.7	42.7	1.8%	5.4	4.01	0.7%
20	Wood	8189	1.1	0.8	0.0%	0.1	0.04	0.0%
21	Opened MRE Inner Packaging	10275	104.8	77.5	3.3%	35.6	26.30	4.4%
22	Neoprene	7866	1.7	1.2	0.1%	0.2	0.13	0.0%
23	MRE Heaters	11019	12.0	8.8	0.4%	1.6	1.17	0.2%
24	Soap	9910	2.2	1.6	0.1%	0.0	0.03	0.0%
25	Nylon	13663	3.0	2.2	0.1%	0.6	0.43	0.1%
26	Rock	0	0.2	0.2	0.0%	0.2	0.11	0.0%
27	Batteries	1403	1.7	1.3	0.1%	0.0	0.01	0.0%
28	Cigarette Waste	6040	8.5	6.3	0.3%	1.3	0.99	0.2%
29	Latex	16055	0.1	0.1	0.0%	0.0	0.01	0.0%

Table G-8. Heat of Combustion, Weight and Volume of Trash and Kitchen Waste (Cont.)

#	Material Category[1]	Heat of Combustion[1]	Total Weight Per Material	Weight of Material	Weight %	Total Volume Per Material	Volume of Material	Volume %
		BTU/lb	lb	lb/FP/day	%	ft^3	ft^3/FP/day	%
30	Lint	5353	0.2	0.1	0.0%	0.1	0.07	0.0%
40[2]	Dining Area Waste	6710	-	-	-	-	-	-
41	NOT USED							
42[2]	Billeting Area	9357	-	-	-	-	-	-
43	Paint Can	13400	3.6	2.7	0.1%	0.21	0.18	0.0%
		Total	3151	2329.5		798	687	

1. See notes on Table G-2.
2. Weight contributions from categories 40 and 42 are divided among the other Material Categories as shown in Tables G-4 and G-2, respectively.

The composition of the Trash and Kitchen Waste is broken down by Material Category in order by percent of overall weight in Table G-9, percent of overall volume in Table G-10, and percent contribution to overall Heat of Combustion in Table G-11. The Material Category produced in the greatest amount by weight is food. If the food and the slop food are added, they comprise approximately 41 % of the overall weight, however they are only about 9% of the overall volume. The Material Category produced in the greatest amount by volume is polystyrene, which is mainly comprised of cups, plates, forks, and knives. They comprise approximately 24% of the overall volume, however they are only about 6% of the overall weight.

Table G-9. Weight Composition of Trash and Kitchen Waste

	Material Category	Weight Percentage
4	Food	23.93%
4a	Slop Food (Wet Food)	17.22%
10	Paper – Brown	16.12%
1	Cardboard	14.43%
13	Paper – Wax	6.84%
17	Plastic – Polystyrene	5.95%
15	Plastic – Polyethylene, Polypropylene	4.55%
21	Opened MRE Inner Packaging	3.33%
19	Unopened MREs	1.83%
8	Metal – Iron	1.49%
14	Plastic – Polyethylene Terephthalate	1.32%
7	Metal – Aluminum	0.90%
23	MRE Heaters	0.38%
3	Fabric – Cotton	0.36%
5	Glass	0.33%
28	Cigarette Waste	0.27%
12	Paper – Newsprint	0.18%
11	Paper – Magazine	0.13%
43	Paint Can	0.12%
25	Nylon	0.09%
24	Soap	0.07%
27	Batteries	0.06%
22	Neoprene	0.05%
20	Wood	0.03%
26	Rock	0.01%
16	Plastic – Polyvinyl Chloride	0.00%
29	Latex	0.00%
30	Lint	0.00%

Table G-10. Volume Composition of Trash and Kitchen Waste

	Material Category	Volume Percentage
17	Plastic – Polystyrene	22.59%
10	Paper – Brown	21.19%
1	Cardboard	19.85%
13	Paper – Wax	11.01%
15	Plastic – Polyethylene, Polypropylene	8.09%
4	Food	7.20%
21	Opened MRE Inner Packaging	3.83%
7	Metal – Aluminum	1.85%
14	Plastic – Polyethylene Terephthalate	1.47%
4a	Slop Food (Wet Food)	1.37%
19	Unopened MREs	0.58%
3	Fabric – Cotton	0.24%
23	MRE Heaters	0.17%
28	Cigarette Waste	0.14%
8	Metal – Iron	0.12%
12	Paper – Newsprint	0.09%
25	Nylon	0.06%
5	Glass	0.05%
43	Paint Can	0.02%
22	Neoprene	0.02%
26	Rock	0.02%
11	Paper – Magazine	0.01%
20	Wood	0.01%
30	Lint	0.01%
24	Soap	0.00%
27	Batteries	0.00%
16	Plastic – Polyvinyl Chloride	0.00%
29	Latex	0.00%

The Material Category with the greatest contribution to the Heat Content of the waste is brown paper. If the brown paper and cardboard are added, they contribute to approximately 44% of the heat content. Most of the cardboard is packaging waste. Most of the brown paper is paper towels. Conversion of the cardboard to plastic would be highly beneficial, since plastic has a heat of combustion 2–3 times as higher, and an ash content 90 percent lower than cardboard or brown paper. Converting any metals and glass used in packaging to plastics would add to the heat of combustion as well, since they are approximately 5–10% (including the metal liners in MRE packaging) of the waste stream by weight, but will not combust or gasify in a thermal conversion process, and do not add anything to the heat of combustion.

Table G-11. Material Category Contribution to Heat of Combustion

	Material Category	Contribution to Heat of Combustion
10	Paper – Brown	18.93%
1	Cardboard	16.95%
17	Plastic – Polystyrene	16.22%
15	Plastic – Polyethylene, Polypropylene	14.53%
13	Paper – Wax	10.10%
4	Food	9.04%
21	Opened MRE Inner Packaging	5.44%
4a	Slop	2.74%
14	Plastic – Polyethylene Terephthalate	2.01%
19	Unopened MREs	1.59%
23	MRE Heaters	0.67%
3	Fabric – Cotton	0.46%
28	Cigarette Waste	0.26%
43	Paint Can	0.25%
12	Paper – Newsprint	0.24%
25	Nylon	0.21%
11	Paper – Magazine	0.12%
24	Soap	0.11%
22	Neoprene	0.07%
20	Wood	0.05%
27	Batteries	0.01%
29	Latex	0.01%
16	Plastic – Polyvinyl Chloride	0.01%
30	Lint	0.01%
2	Fabric – Acrylic	0.00%
5	Glass	0.00%
6	Leather	0.00%
7	Metal – Aluminum	0.00%
8	Metal – Iron	0.00%
9	Metal – Magnesium	0.00%
18	Tire Rubber	0.00%
26	Rock	0.00%

Calculation 4:

Average Heat of Combustion for Trash and Kitchen Waste for Table G-2

Data Given:

Average population per day (from Table 3.1) = 163.7 person

Study Length (Trash and Kitchen Waste were characterized from 6/18-6/23) = 5 days

Weight of Individual Material Categories from Table G-6

Find:

Average Heat of Combustion for Trash and Kitchen Waste for Table G-2

Step 1: Calculate Total Heat Content for each Material Category

Example: Calculation of Total Heat Content for Material Category 1 – Cardboard

Total Heat Content = (Heat of Combustion) × (Daily Wt. prod. by Full Force Provider)

Total Heat Content = (7370 BTU/lb) × (336.2 lb.) = 2,477,671 BTU

Step 2: Sum Total Weight for All Material Categories

Example: For Current Situation, including Slop

Sum Total Weight = Sum of Column 4 = 2329.5 lb.

Step 3: Sum Heat Content for All Material Categories

Sum Heat Content = Sum of Column 5 = 14,620,276 BTU

Step 4: Calculate Average Heat of Combustion for All Material Categories

Average Heat of Combustion = (Sum Heat Content) / (Sum Total Weight)

Average Heat of Combustion = (2329.5 lb.) / (14,620,276 BTU)
= 6276 BTU/lb
≈ 6300 BTU/lb

The 'Current' columns calculate the average heat of combustion for the trash and kitchen waste in its current state, including the slop food waste. They show the amount of heat expected to be generated if these wastes are converted directly to energy, if the slop food is not composted.

The 'Current Without Slop Food' columns calculate the average heat of combustion for the trash and kitchen waste in its current state, without slop food waste. They show the amount

of heat expected to be generated if these wastes are converted directly to energy, if the slop food is composted.

The 'After Completion and Implementation of Designer Trash Program (Minimum)' columns calculate the minimum average heat of combustion for the trash and kitchen waste if the designer trash program is implemented. This program would work to eliminate non-combustible wastes. The calculation of this column assumes the following:

1. All metal and glass wastes are military supply packaging wastes (the data from this study confirms this).
2. All metal and glass packaging is replaced with a plastic having a high heat content, such as polyethylene, which will have a similar weight. The metal and glass weights are subtracted from their respective Material Categories, and added to the polyethylene category, raising the weight of polyethylene from 143.4 lb. to 229.1 lb.
3. All MRE packaging is redesigned be plastic only, and the metal foil is removed. This would raise the heat of combustion of the Opened MRE packaging to approximately 20,000 BTU/lb, and the Unopened MREs to 10,000 BTU/lb.

The 'After Completion and Implementation of Designer Trash Program (Maximum)' columns calculate the maximum average heat of combustion for the trash and kitchen waste if the designer trash program is implemented and includes replacing some of the cardboard Material Category with plastic. The calculation of this column assumes the following:

1. If the MRE cardboard boxes were changed to plastic, this would raise the heat of combustion even higher, however since the percentage of this category that is attributed to MRE packaging was not recorded, this column can only be estimated.
2. Based on the observations of the Study Team, a <u>minimum of 50%</u> of the cardboard waste was MRE packaging. It may be as high as 75–80%.
3. This column assumes 50% of this cardboard by weight is changed to Polyethylene.

Table G-12. Average Heats of Combustion for Waste Stream

#	Material Category[1]		Current		Current Without Slop Food		After Completion and Implementation of Designer Trash Program (Minimum)		After Completion and Implementation of Designer Trash Program (Maximum)	
		Heat of Combustion (BTU/lb)	Total Weight (lb/FP/ day)	Total Heat Content (BTU/FP/ day)	Total Weight (lb/FP/ day)	Total Heat Content (BTU/FP/ day)	Total Weight (lb/FP/ day)	Total Heat Content (BTU/FP/ day)	Total Weight (lb/FP/ day)	Total Heat Content (BTU/FP/ day)
1	Cardboard	7370	336.2	2477671	336.2	2477671	336.2	2477671	168.1	1238835
2	Fabric – Acrylic	0	0.0	0	0.0	0	0.0	0	0.0	0
3	Fabric – Cotton	7974	8.4	66912	8.4	66912	8.4	66912	8.4	66912
4	Food	2370	557.4	1321005	557.4	1321005	557.4	1321005	557.4	1321005
4a	Slop Food (Wet Food)	1000	401.1	401098		0		0		0
5	Glass	0	7.7	0	7.7	0	0.0	0	0.0	0
6	Leather	0	0.0	0	0.0	0	0.0	0	0.0	0
7	Metal – Aluminum	13378	20.9	0	20.9	0	0.0	0	0.0	0
8	Metal – Iron	3185	34.7	0	34.7	0	0.0	0	0.0	0
9	Metal – Magnesium	0	0.0	0	0.0	0	0.0	0	0.0	0
10	Paper – Brown	7370	375.4	2767037	375.4	2767037	375.4	2767037	375.4	2767037
11	Paper – Magazine	5474	3.1	17118	3.1	17118	3.1	17118	3.1	17118
12	Paper – Newsprint	8491	4.2	35540	4.2	35540	4.2	35540	4.2	35540
13	Paper – Wax	9267	159.4	1477248	159.4	1477248	159.4	1477248	159.4	1477248
14	Plastic – Polyethylene Terephthalate	9560	30.8	294177	30.8	294177	30.8	294177	30.8	294177
15	Plastic – Polyethylene, Polypropylene	20043	106.0	2124201	106.0	2124201	169.4	3394537	274.1	5493262
16	Plastic – Polyvinyl Chloride	7737	0.1	876	0.1	876	0.1	876	0.1	876

Table G-12. Average Heats of Combustion for Waste Stream (Cont.)

#	Material Category[1]		Current		Current Without Slop Food		After Completion and Implementation of Designer Trash Program (Minimum)		After Completion and Implementation of Designer Trash Program (Maximum)	
		Heat of Combustion (BTU/lb)	Total Weight (lb/FP/day)	Total Heat Content (BTU/FP/day)	Total Weight (lb/FP/day)	Total Heat Content (BTU/FP/day)	Total Weight (lb/FP/day)	Total Heat Content (BTU/FP/day)	Total Weight (lb/FP/day)	Total Heat Content (BTU/FP/day)
17	Plastic – Polystyrene	17111	138.6	2370778	138.6	2370778	138.6	2370778	138.6	2370778
18	Tire Rubber	0	0.0	0	0.0	0	0.0	0	0.0	0
19[3]	Unopened MREs	5458	42.7	232890	42.7	232890	42.7	426715	42.7	426715
20	Wood	8189	0.8	6616	0.8	6616	0.8	6616	0.8	6616
21[3]	Opened MRE Inner Packaging	10275	77.5	795954	77.5	795954	77.5	1549278	77.5	1549278
22	Neoprene	7866	1.2	9807	1.2	9807	1.2	9807	1.2	9807
23	MRE Heaters	11019	8.8	97485	8.8	97485	8.8	97485	8.8	97485
24	Soap	9910	1.6	16304	1.6	16304	1.6	16304	1.6	16304
25	Nylon	13663	2.2	30221	2.2	30221	2.2	30221	2.2	30221
26	Rock	0	0.2	0	0.2	0	0.2	0	0.2	0
27	Batteries	1403	1.3	1766	1.3	1766	1.3	1766	1.3	1766
28	Cigarette Waste	6040	6.3	37779	6.3	37779	6.3	37779	6.3	37779
29	Latex	16055	0.1	1187	0.1	1187	0.1	1187	0.1	1187
30	Lint	5353	0.1	791	0.1	791	0.1	791	0.1	791
40[2]	Dining Area Waste	13400	2.7	35813	2.7	35813	2.7	35813	2.7	35813
41	NOT USED									
42[2]	Billeting Area	9357	-	-	-	-	-	-	-	-
43	Paint Can	13400	3.6	48441	Same	48441	Same	48441	Same	48441

Table G-12. Average Heats of Combustion for Waste Stream (Cont.)

#	Material Category[1]		Current		Current Without Slop Food		After Completion and Implementation of Designer Trash Program (Minimum)		After Completion and Implementation of Designer Trash Program (Maximum)	
		Heat of Combustion (BTU/lb)	Total Weight (lb/FP/day)	Total Heat Content (BTU/FP/day)	Total Weight (lb/FP/day)	Total Heat Content (BTU/FP/day)	Total Weight (lb/FP/day)	Total Heat Content (BTU/FP/day)	Total Weight (lb/FP/day)	Total Heat Content (BTU/FP/day)
	Totals		2329.5	14620276	1928.4	14219178	1928.4	16436662	1865.0	17296552
Average Heat of Combustion (BTU/lb)				6276 ≈6300		7374 ≈7400		8524 ≈ 8500		9628 ≈ 9600

1. See notes on Table G-2.
2. Weight contributions from categories 40 and 42 are divided among the other Material Categories as shown in tables G-4 and G-2, respectively.
3. Although the weight of these materials would not change, their heats of combustion would increase, since the metal and glass would be changed to a plastic with a high heat of combustion. (See Calculations Above)

Calculation 5:

Electrical Generation and Annual Fuel Savings

The baseline case for electrical generation, heat generation, and associated fuel savings is the current situation, including the slop.

Data Given:

Total Daily Heat Content in Trash = 14,620,276 BTU/Day (from Table G-9)

Total Daily Heat Content in Waste Kitchen Oil = 2,030,000 BTU/Day (from Calculation 2)

Efficiency of WEC for Electrical Generation ≈ 25%

Fuel Usage Rate for 60 kW TQG = 5 Gal Diesel/ hr = 120 Gal Diesel/day

Find:

Daily Electrical Generation and Annual Fuel Savings

Step 1: Calculate the Maximum Theoretical Electrical Generation per Day

Max. Theoretical kW-Hr/Day = (Total Daily Heat Content in Trash + Total Daily Heat Content in Oil) × (Conversion Constant)

Max. Theoretical kW-Hr/Day = (14,620,276 + 2,030,000) BTU/Day × (0.000292875 kW-Hr/BTU) = 4875 kW-Hr/Day

Step 2: Calculate the Expected Electrical Generation per Day

Expected kW-Hr/Day = (Max. Theoretical kW-Hr/Day) × (Efficiency of WEC)

Expected kW-Hr/Day = (4875 kW-Hr/Day) × (25%) = 1218 kW-Hr/Day

Step 3: Calculate the Constant Electrical Generation Rate

Constant kW = (Expected kW-Hr/Day) × (Day / Hrs of Operation)

Constant kW = (1218 kW-Hr/Day) × (Day / 24 Hr) = 50 kW Answer.

OR

Constant kW = (1218 kW-Hr/Day) × (Day / 18 Hr) = 68 kW

Step 4: Calculate the Daily and Annual Fuel Savings

Daily Fuel Savings = (Hrs/day operation) × (Fuel Usage Rate for 60 kW TQG)

Daily Fuel Savings = (50 kW / 60 kW) (24 Hr/day) × (5 Gal Diesel/Hour) = 100 Gal Diesel / Day

Annual Fuel Savings = (Daily Fuel Savings) × (365 days/year)

Annual Fuel Savings = (100 Gal Diesel / Day) × (365 days/year) = 36,500 Gal Diesel / Year

Table G-13. Energy Generation: Option 1 – Electricity

	Current	Current Without Slop Food	After Completion and Implementation of Designer Trash Program (Minimum)	After Completion and Implementation of Designer Trash Program (Maximum)
Total BTU/Day	14620276	14219178	16436662	18566888
BTU From Waste Kitchen Oil	2030000	2030000	2030000	2030000
kW-Hr/day	4875	4758	5407	6031
Estimated Efficiency	25%	0.25	0.25	0.25
kW-Hr/day	1219	1189	1352	1508
kW Constant	51	50	56	63
60 kW TQG Fuel Rate (gal Diesel/day)	120	120	120	120
Heat of Combustion for Diesel #2 (BTU / gal)	132000	132000	132000	132000
60 kW TQG Efficiency	31%	31%	31%	31%
Gallons Saved/day	102	100	112	126
Gallons Saved/Year	37230	36500	40880	45990

Calculation 6:

Hot Air Generation and Annual Fuel Savings

Example: For Current Situation.

<u>Data Given:</u>

Total Daily Heat Content in Trash = 14,620,276 BTU/Day (from Table G-9)

Total Daily Heat Content in Waste Kitchen Oil = 2,030,000 BTU/Day (from Calculation 2)

Efficiency of WEC for Hot Air Generation ≈ 75%

Fuel Usage rate for 120,000 BTU / Hour Area Space Heater (ASH) = 24 Gal Diesel / Day

Find:

Daily Hot Air Generation and Annual Fuel Savings

Step 1: Calculate the Expected Heat Generation per Hour

Expected BTU/ Hour = (Total Daily Heat Content in Trash + Total Daily Heat Content in Waste Kitchen Oil) × (Efficiency of WEC) × (Day / 24 Hour)

Expected BTU / Hour = (14,620,276 + 2,030,000) BTU/Day × (75%) × (Day / 24 Hour) = 520,213 BTU/Hr

Step 2: Calculate the Number of 120,000 BTU / Hour ASH Displaced

Number of 120,000 BTU / Hour ASH Displaced = (Expected BTU/HR) / (BTU/HR produced by ASH)

Number of 120,000 BTU / Hour ASH Displaced = (520,213 BTU/Hr) / (120,000 BTU/HR) = 4.3 ≈ 4

Step 3: Calculate the Daily and Annual Fuel Savings

Daily Fuel Savings = (Number of ASH Displaced) × (Fuel Usage Rate for 120,000 BTU / HR ASH)

Daily Fuel Savings = (4) × (24 Gal Diesel/day) = 96 Gal Diesel / Day

Annual Fuel Savings = (Daily Fuel Savings) × (365 days/year)

Annual Fuel Savings = (96 Gal Diesel / Day) × (365 days/year) = 35,040 Gal Diesel / Year

Table G-14. Energy Generation: Option 2 – Hot Air

	Current	Current Without Slop Food	After Completion and Implementation of Designer Trash Program (Minimum)	After Completion and Implementation of Designer Trash Program (Maximum)
Total BTU/Day	14620942	14219843	16437533	18567808
BTU From Waste Kitchen Oil	2025885	2025885	2025885	2025885
Estimated Efficiency	75%	75%	75%	75%
BTU/Hr	520213	507679	576982	643553
Number of 120,000 BTU / Hour ASH Displaced:	4	4	5	5
120,000 BTU / Hour ASH Fuel Rate (gal diesel/day)	24	24	24	24
Heat of Combustion for Diesel #2 (BTU / gal)	132000	132000	132000	132000
120,000 BTU / Hour ASH Efficiency	91%	91%	91%	91%
Gallons Saved/day	96	96	120	120
Gallons Saved/Year	35040	35040	43800	43800

Calculation 7:

Hot Water Generation and Annual Fuel Savings
Using the Current Situation as an example:

Data Given:

Total Daily Heat Content in Trash = 14,620,276 BTU/Day (from Table G-9)

Total Daily Heat Content in Waste Kitchen Oil = 2,030,000 BTU/Day (from Calculation 2)

Efficiency of WEC for Hot Water Generation ≈ 75%

Fuel Usage rate for M-80 Water Heater = 40 Gal Diesel / Day

Heat Rating of M-80 Water Heater: 500,000 BTU/hr

Find:

Daily Hot Water Generation and Annual Fuel Savings

Step 1: Calculate the Expected Heat Generation per Hour

Expected BTU/ Hour = (Total Daily Heat Content in Trash + Total Daily Heat Content in Waste Kitchen Oil) × (Efficiency of WEC) × (Day / 24 Hour)

Number of Hours per Day M-80 Runs = 8 hours/day

Expected BTU / Hour = (14,620,276 + 2,030,000) BTU/Day × (75%) × (Day / 8 Hour) = 1,560,640 BTU/Hr

Step 2: Calculate the Number of M-80 Water Heaters Displaced

Number of M-80 Water Heaters Displaced = (Expected BTU/HR) / (BTU/HR produced by M-80)

Number of M-80 Water Heaters Displaced = (1,560,640 BTU/HR) / (500,000 BTU/HR) = 3.1 ≈ 3

Step 3: Calculate the Daily and Annual Fuel Savings

Daily Fuel Savings = (Number of M-80 Displaced) × (Fuel Usage Rate for M-80)

Daily Fuel Savings = (3) × (40 Gal Diesel/day) = 120 Gal Diesel / Day

Annual Fuel Savings = (Daily Fuel Savings) × (365 days/year)

Annual Fuel Savings = (120 Gal Diesel / Day) × (365 days/year) = 43,800 Gal Diesel / Year

Table G-15. Energy Generation: Option 3 – Hot Water

	Current	Current Without Slop Food	After Completion and Implementation of Designer Trash Program (Minimum)	After Completion and Implementation of Designer Trash Program (Maximum)
Total BTU/Day(Trash and Kitchen Waste)	14620942	14219843	16437533	18567808
Total BTU/Day(Waste Kitchen Oil)	2025885	2025885	2025885	2025885
Estimated Efficiency	75%	75%	75%	75%
BTU/Hr	1560640	1523037	1730945	1930659
Heat Output for M-80	500000	500000	500000	500000
Number of M-80 Displaced:	3	3	3	4
M-80 Fuel Rate (gal diesel/day)	40	40	40	40
Hours Run per day	8	8	8	8
Heat of Combustion for Diesel #2 (BTU / gal)	132000	132000	132000	132000
M-80 Efficiency (Estimated)	95%	95%	95%	95%
Gallons Saved/day	120	120	120	160
Gallons Saved/Year	43800	43800	43800	58400

Calculation 8:
Volume Reduction after Processing by WEC

Data Given:

Volume Reduction of Material Categories: Material Category Volume Reductions are estimated based on their expected ash content for organic-based materials. Inorganic materials are assumed to have no volume reduction.

Designer Trash: The same assumptions that are made for calculation 4 for designer trash minimum and maximum estimates are made for this calculation.

Find:
Total Volume Reduction after Processing by WEC
Using Current Situation, Cardboard as an example:

Step 1: $\text{Volume after Combustion} = \text{Total Volume per Material} \times (1 - \text{Volume Reduction})$

$$136.42 \frac{\text{ft}^3}{\text{FP} \cdot \text{Day}} \times (1 - 90\%) = 13.64 \frac{\text{ft}^3}{\text{FP} \cdot \text{Day}}$$

Step 2: Sum Total Volumes for All Material Categories

$$= \Sigma \text{ Column } 3 = 689 \text{ ft}^3$$

Step 3: Sum Volumes after Combustion for All Material Categories

$$= \Sigma \text{ Column } 5 = 69 \text{ ft}^3$$

Step 4: Calculate the Overall Volume Reduction

$$= \left(1 - \frac{\text{Sum of Total Volumes}}{\text{Sum of Volumes after Combustion}}\right) \times 100\%$$

$$= \left(1 - \frac{69 \text{ ft}^3}{689 \text{ ft}^3}\right) \times 100\% = 89.98\% \approx 90\%$$

Table G-16. Average Volume Reduction for Waste Stream

#	Material Category[1]	Total Volume Per Material	Material Category Volume Reduction	Volume after Combustion (Current)	Volume after Combustion (Without Slop)	Volume after Combustion After Designer Trash (Minimum)	Volume after Combustion After Designer Trash (Maximum)
		ft^3/FP/day	%	ft^3/FP/day	ft^3/FP/day	ft^3/FP/day	ft^3/FP/day
1	Cardboard	136.42	90%	13.64	13.64	13.64	6.82
2	Fabric – Acrylic	0.00	99%	0.00	0.00	0.00	0.00
3	Fabric – Cotton	1.64	90%	0.16	0.16	0.16	0.16
4	Food	49.49	90%	4.95	4.95	4.95	4.95
4a	Slop	9.42	97%	0.28	0	0.28	0.28
5	Glass	0.38	0%	0.38	0.38	0.00	0.00
6	Leather	0.00	90%	0.00	0.00	0.00	0.00
7	Metal – Aluminum	12.73	0%	12.73	12.73	0.13	0.13
8	Metal – Iron	0.81	0%	0.81	0.81	0.01	0.01
9	Metal – Magnesium	0.00	0%	0.00	0.00	0.00	0.00
10	Paper – Brown	145.53	90%	14.55	14.55	14.55	14.55
11	Paper – Magazine	0.06	90%	0.01	0.01	0.01	0.01
12	Paper – Newsprint	0.61	90%	0.06	0.06	0.06	0.06
13	Paper – Wax	75.66	95%	3.78	3.78	3.78	3.78
14	Plastic – Polyethylene Terephthalate	10.14	99%	0.10	0.10	0.10	0.10
15	Plastic – Polyethylene, Polypropylene	55.56	99%	0.56	0.56	0.56	1.24
16	Plastic – Polyvinyl Chloride	0.01	99%	0.00	0.00	0.00	0.00
17	Plastic – Polystyrene	155.20	99%	1.55	1.55	1.55	1.55
18	Tire Rubber	0.00	99%	0.00	0.00	0.00	0.00
19	Unopened MREs	4.01	55%	1.81	1.81	0.04	0.04
20	Wood	0.04	90%	0.00	0.00	0.00	0.00
21	Opened MRE Inner Packaging	26.30	51%	12.89	12.89	0.26	0.26
22	Neoprene	0.13	99%	0.00	0.00	0.00	0.00
23	MRE Heaters	1.17	90%	0.12	0.12	0.12	0.12
24	Soap	0.03	99%	0.00	0.00	0.00	0.00
25	Nylon	0.43	99%	0.00	0.00	0.00	0.00
26	Rock	0.11	0%	0.11	0.11	0.11	0.11
27	Batteries	0.01	0%	0.01	0.01	0.01	0.01
28	Cigarette Waste	0.99	90%	0.10	0.10	0.10	0.10
29	Latex	0.01	99%	0.00	0.00	0.00	0.00
30	Lint	0.07	99%	0.00	0.00	0.00	0.00

Table G-16. Average Volume Reduction for Waste Stream (Cont.)

#	Material Category[1]	Total Volume Per Material	Material Category Volume Reduction	Volume after Combustion (Current)	Volume after Combustion (Without Slop)	Volume after Combustion After Designer Trash (Minimum)	Volume after Combustion After Designer Trash (Maximum)
43	Paint Can	0.18	50%	0.09	0.09	0.09	0.09
--	Waste Kitchen Oil	2.10	99%	0.02	0.02	0.02	0.02
	Total Volume	689		69	68	41	34
			Overall Volume Reduction	90.0%	89.9%	94.1%	95.0%